(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 488 219 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
12.03.1997 Bulletin 1997/11

(51) Int Cl.6: C08G 18/32, C08G 18/66, C08G 18/50

(21) Application number: 91120280.2

(22) Date of filing: 27.11.1991

(54) Polyurethane, process for producing the same, and process for producing polyurethane foam

Polyurethan, Verfahren zu ihrer Herstellung und Verfahren zur Polyurethanschaumherstellung

Polyuréthane, procédé pour sa préparation et procédé pour la préparation de mousse de polyuréthane

(84) Designated Contracting States:
DE ES FR GB

(30) Priority: 27.11.1990 JP 326696/90
10.05.1991 JP 105674/91
10.05.1991 JP 105675/91
10.05.1991 JP 105676/91
10.05.1991 JP 105677/91

(43) Date of publication of application:
03.06.1992 Bulletin 1992/23

(73) Proprietor: KAO CORPORATION
Chuo-ku, Tokyo (JP)

(72) Inventors:
- Harada, Shoichiro
  Wakayama-shi, Wakayama (JP)
- Isayama, Yasutoshi
  Wakayama-shi, Wakayama (JP)
- Fukushima, Tetsuaki
  Wakayama-shi, Wakayama (JP)
- Morii, Masayoshi
  Naga-gun, Wakayama (JP)
- Kitagawa, Hiroshi
  Wakayama-shi, Wakayama (JP)
- Abe, Hiroshi
  Albany, CA 94706 (US)

(74) Representative:
Hansen, Bernd, Dr. Dipl.-Chem. et al
Hoffmann, Eitle & Partner
Patent- und Rechtsanwälte,
Postfach 81 04 20
81904 München (DE)

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US-A- 3 437 608
WO-A-86/01522
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US-A- 3 325 306

Remarks:
The file contains technical information submitted after the application was filed and not included in this specification

EP 0 488 219 B1

Printed by Jouve, 75001 PARIS (FR)

Description

Field of the Invention

The present invention relates to a novel polyurethane, a process for producing the same, and a process for producing a polyurethane foam. More particularly, the present invention is concerned with a process for producing a polyurethane which gives a polyurethane excellent moldability in mold filling substantially without the necessity for using a catalyst component commonly used for producing a polyurethane, a polyurethane produced by the process, a process for producing a rigid polyurethane foam excellent in mold filling, thermal insulation property and low-temperature dimensional stability, a process comprising a spray step for producing a rigid polyurethane foam having excellent mechanical properties and adhesive property whereby the reaction of a polyol with an isocyanate can sufficiently proceed at low temperature, and a process for producing a foamed-in-mold flexible polyurethane foam for use in furniture and automobile cushions. More particularly, the present invention relates to a process for producing a flexible polyurethane foam by using a urethane feedstock containing a particular tertiary aminoalcohol and having an excellent high temperature moldability at the time of pouring of a urethane feedstock in mold foaming.

Description of the Related Art

Polyurethanes are used in various industrial fields, such as elastomer, rigid foam, semirigid foam, flexible foam and microcellular foam, by virtue of their easiness of control of molding density, hardness of products and various properties and their excellent moldability. In producing these polyurethanes, it is a common practice to use a tertiary amine or an organometallic catalyst as a polyurethane producing catalyst in addition to a polyisocyanate component and a polyol component for the purpose of promoting curing or foaming, which enables a polyurethane to be produced on an industrial scale.

Among the polyurethane producing catalysts, tertiary amines are widely used because they are useful for controlling the balance of the reaction. In many cases, however, they have a strong irritating odor and skin irritation and therefore have problems of the working environment and a drawback that the odor lowers the value of the product.

Therefore present inventors have proposed using of a tertiary amino alcohol represented by the general formula (0):

$$\mathrm{HO{-}[{-}R_a{-}\overset{\displaystyle R_b}{\overset{|}{N}}{-}]_l{-}R_a{-}OH} \qquad (0)$$

in which R_a is a C_2 to C_{24} straight-chain or branched alkylene group, an alicyclic alkylene group, an aralkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$ (where p is 0 or a positive integer and q is a positive integer), R_b is a C_1 to C_{24} straight-chain or branched alkyl group or an aralkyl group and 1 is a positive integer of 2 to 50,
as a catalyst and a raw material for polyurethane production (Refer to U. S. Patent Application No.563712).

Further, when a rigid polyurethane foam or the like is molded by mold foaming for a use of a refrigerator or a panel, an improvement in the mold filling relating to the fluidity of the resin within a mold is required, so that a method for lowering the density in a high yield has been desired in the art.

In recent years, the use of chlorofluorocarbons as a foaming agent is legally regulated for the protection of the ozonosphere and trichlorofluoromethane (R-11) which has hitherto been used for the production of a rigid polyurethane foam is among the substances subject to the regulation, which brings about a problem of the necessity for reducing the use of trichlorofluoromethane. Examples of the reduction means proposed in the art include one wherein the amount of use of water is increased to reduce that of trichlorofluoromethane (the so-called "chlorofluorocarbons-poor formulation") and one wherein use is made of 1,1-dichloro-2,2,2-trifluoroethane (R-123) or 2,2-dichloro-2-fluoroethane (R-141b) having an ozone destruction factor (ODP) smaller than that of trichlorofluoromethane.

In the chlorofluorocarbons-poor formulation wherein the amount of use of water as a foaming agent is increased, the increase in the amount of water inevitably accelerates the reaction of water with the polyisocyanate component. This causes the amount of formation of a urea bond derived from the evolution of carbon dioxide to be increased, so that the balance between the foaming reaction and the resinification reaction is lost, which causes the mold filling of the polyurethane form to be significantly lowered. The use of 1,1-dichloro-2,2,2-trifluoroethane or 2,2-dichloro-2-fluoroethane instead of trichlorofluoromethane makes it necessary to increase the amount of use of water, because the low temperature dimensional stability, compressive strength and mold filling are lowered thereby. This, however, causes the mold filling to be further lowered.

The rigid polyurethane foam comprising a spray step for producing thereof (a spray type rigid polyurethane foam,

hereinafter) is used mainly for the thermal insulation of the internal wall and ceiling of houses and the thermal insulation of tanks. A special foaming machine is used for the foaming work of the spray type rigid polyurethane foam. An air spray foaming machine is a system wherein compressed air is introduced into a mixing gun, while an airless foaming machine is a system wherein a feedstock is introduced into a mixing gun through the use of a lightweight compresser and then sprayed. A liquid mixture comprising a polyol component and an isocyanate component is sprayed on a face of an article through the use of the above-described foaming machines, and a thermal insulation layer comprising a rigid polyurethane foam is formed on that face through the utilization of the property of the mixture of rapidly thickening, foaming and forming a high-molecular polymer.

The above-described useful spray type rigid polyurethane foam had found an expanded application, and an increase in the amount of use thereof has brought about various problems. One of the problems is that the bonding strength between the foam and the adherend material is so poor, that the foam peels off or falls down with the lapse of time to impair the thermal insulation effect, so that dewing becomes liable to occur.

Further, the regulation of the use of chlorofluorocarbons such as trichlorofluoromethane has brought about a tendency that the amount of incorporation of water in the foaming agent is increased, which further renders the above-described problems serious. Specifically, when the amount of the chlorofluorocarbon subject to the regulation is reduced by increasing the amount of incorporation of water, the agglomeration caused by a urea bond formed by the reaction of water with the isocyanate violently occurs and further the boundary between the urethane foam and the adherend or the surface of the foam suffers from less accumulation of the heat of reaction, which brings about drawbacks such as a lack in the self-bonding strength which is the most important property of the spray type rigid polyurethane foam and an increase in the fragility. This tendency becomes conspicuous in conducting the spraying at a relatively low temperature of 5°C or below.

The flexible hot mold foam is produced by blending and sufficiently mixing a polyether polyol, a polyisocyanate, a foaming agent, a silicone foam stabilizer and a catalyst with each other, pouring the mixture into a mold and then heating the mixture to allow a reaction to proceed. In this case, after the temperature of the mold is adjusted to 35 to 45°C, a urethane feed-stock is poured into the mold to conduct foaming and cured in a furnace at 160 to 200°C, and the cured foam is demolded. The reason why the temperature of the mold is adjusted to 35 to 45°C resides in that when it is below 35°C, an increase in the foam density and insufficient curing of the foam are liable to occur and further the time taken from the pouring to the demolding is lengthened, which hinders the production of the foam. When the temperature of the mold exceeds 45°C, a crack occurs within the foam, so that no good product can be obtained. Although trichlorofluoromethane is used in the production of a foam having a low density and a low hardness, it is desired to reduce or discontinue the use of trichlorofluoromethane for the reasons mentioned hereinabove.

Therefore, if a good foam can be uinformly produced at a mold temperature of 45°C or above, the step of cooling the mold after the demolding of the foam in a foam production line can be remarkably omitted, which contributes to the prevention of energy loss. Further, the foam produced at a higher mold temperature has a lowered density due to an enhancement in the foaming efficiency. In attaining the same density as that of the foam at an ordinary mold temperature, the amount of the foaming agent can be reduced, whereby the use of the chlorofluorocarbons subject to the regulation can be reduced or discontinued.

US-A-3 325 306 and FR-A-2 118 001 describe a polyurethane prepared by reacting a polyisocyanate component with a polyol component, the polyol component comprising, as all or part thereof, a tertiary amino alcohol having the formula $(HO\text{-}R[\text{-}N(R')]_n\text{-}R\text{-}OH$ with n = 1.

Furthermore, US-A-3 437 608 refers to a moldable polyurethane foam prepared by reacting a polyisocyanate component with a polyether polyol or a polyester polyol and a gel-rise retardation agent which is selected from methyldiethanolamine, $HO\text{-}C_2H_4[\text{-}N(Me)]n\text{-}C_2H_4\text{-}OH$ (n = 1), and dimethylaminoethanol, $Me_2NCH_2CH_2\text{-}OH$.

Finally, WO-A-86/01522 discloses a polyurethane foam prepared by reacting a polyisocyanate with an active hydrogencontaining composition comprising a polyol, water as a blowing agent and a dialkanol tertiary amine, $OH\text{-}R[\text{-}N(R')]_n\text{-}R\text{-}OH$ (n = 1).

SUMMARY OF THE INVENTION

The present inventors have made intensive studies with a view to solving the above-described problems and, as a result, have found that in the production of a polyurethane and a polyurethane foam from a polyisocyanate component and a polyol component, the use of a tertiary aminoalcohol represented by the general formula (I)

$$HO\text{-}[\text{-}R_1\text{-}\underset{\displaystyle |}{\overset{\displaystyle R_2}{\overset{|}{N}}}\text{-}]_n\text{-}R_1\text{-}OH \qquad (I)$$

in which R_1 each is an alkylene having 2 to 24 carbon atoms, being straight or branched, a cycloalkylene having 3 to 24 carbon atoms, an alicyclic alkylene having 4 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group, an arylene having 6 to 24 carbon atoms, an aralkylene having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being a positive number, R_2 each is an alkyl having 1 to 24 carbon atoms, being straight or branched, an aryl having 6 to 24 carbon atoms or an aralkyl having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group and n is a positive number of more than 1 and up to 50 on the average, as part or the whole of the polyol component enables to produce a polyurethane and a polyurethane foam substantially without the necessity for using a catalyst such as a tertiary amine, and the resultant polyurethane and polyurethane foam have improved properties in respect of mold filling, thermal insulation, low-temperature dimensional stability, etc., which has led to the completion of the present invention.

Accordingly, the first embodiment of the present invention provides a process for producing a polyurethane, comprising the step of reacting a polyisocyanate component with a polyol component, the polyol component comprising, as all or part thereof, a tertiary aminoalcohol having the formula (I):

$$HO-[-R_1-\underset{\displaystyle |}{\overset{\displaystyle R_2}{N}}-]_n-R_1-OH \qquad (I)$$

in which R_1 each is an alkylene having 2 to 24 carbon atoms, being straight or branched, a cycloalkylene having 3 to 24 carbon atoms, an alicyclic alkylene having 4 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group, an arylene having 6 to 24 carbon atoms, an aralkylene having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being a positive number, R_2 each is an alkyl having 1 to 24 carbon atoms, being straight or branched, an aryl having 6 to 24 carbon atoms or an aralkyl having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group and n is a positive number of more than 1 and up to 50 on the average.

It is preferable that the n in the formula (I) is a positive number of 2 to 50.

It is preferable that R_1 each is an alkylene having 6 to 9 carbon atoms, being straight or branched, R_2 each is an alkyl having 1 to 4 carbon atoms, being straight or branched, and n is an integral number of 2 to 18 in the formula (I).

Furthermore, it is preferable to use a tertiary aminoalcohol having the formula (II):

$$HO-[-R_3-\overset{\displaystyle R_4}{\overset{\displaystyle |}{N}}-]_m-R_4 \qquad (II)$$

in which R_3 each is an alkylene having 2 to 24 carbon atoms, being straight or branched, a cycloalkylene having 3 to 24 carbon atoms, an alicyclic alkylene having 4 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group, an arylene having 6 to 24 carbon atoms, an aralkylene having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being a positive number, R_4 each is an alkyl having 1 to 24 carbon atoms, being straight or branched, an aryl having 6 to 24 carbon atoms or an aralkyl having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group and m is a positive number of more than 1 and up to 50; as a third component in the step of reacting a polyisocyanate component with the polyol component.

The amount of the third component having the formula (II) is preferably 30 % and less by weight based on the total amount of the tertiary aminoalcohol having the formula (I) and the tertiary aminoalcohol having the formula (II) when the third component is used.

It is preferable that the polyol component includes 1 to 50 % by weight of the tertiary aminoalcohol having the formula (I).

It is preferable that R_1 each is $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero to 15, q being 1 to 15, and/or that R_3 each is $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero to 15, q being 1 to 15.

It is also preferable that R_1 each is an alkylene having 6 to 9 carbon atoms, being straight or branched, R_2 each is an alkyl having 1 to 4 carbon atoms, being straight or branched, and n is 1 to 30 in the formula (I), and/or that R_3 each is an alkylene having 6 to 9 carbon atoms, being straight or branched, R_4 each is an alkyl having 1 to 4 carbon atoms, being straight or branched, and m is more than 1 and up to 30 in the formula (II) when the third component is used.

The second embodiment of the present invention provides a polyurethane for producing by above-mentioned process.

The third embodiment of the present invention provides a process for producing a polyurethane foam, comprising the step of reacting a polyisocyanate component with a polyol component coexisting of a foaming agent, the polyol component comprising, as all or part thereof, a tertiary aminoalcohol having the formula (I):

$$HO-[-R_1-\underset{\displaystyle R_2}{\overset{|}{N}}-]_n-R_1-OH \qquad (I)$$

in which R_1 each is an alkylene having 2 to 24 carbon atoms, being straight or branched, a cycloalkylene having 3 to 24 carbon atoms, an alicyclic alkylene having 4 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group, an arylene having 6 to 24 carbon atoms, an aralkylene having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being a positive number, R_2 each is an alkyl having 1 to 24 carbon atoms, being straight or branched, an aryl having 6 to 24 carbon atoms or an aralkyl having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group and n is a positive number of more than 1 and up to 50.

It is preferable that the n in the formula (I) is an integral number of 2 to 50.

Furthermore, it is preferable to use a tertiary aminoalcohol having the formula (II):

$$HO-[-R_3-\underset{\displaystyle R_4}{\overset{|}{N}}-]_m-R_4 \qquad (II)$$

in which R_3 each is an alkylene having 2 to 24 carbon atoms, being straight or branched, a cycloalkylene having 3 to 24 carbon atoms, an alicyclic alkylene having 4 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group, an arylene having 6 to 24 carbon atoms, an aralkylene having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being a positive number, R_4 each is an alkyl having 1 to 24 carbon atoms, being straight or branched, an aryl having 6 to 24 carbon atoms or an aralkyl having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group and m is a positive number of more than 1 and up to 50; as a third component in the step of reacting a polyisocyanate component with the polyol component.

The amount of the third component having the formula (II) is preferably 30 % and less by weight based on the total amount of the tertiary aminoalcohol having the formula (I) and the tertiary aminoalcohol having the formula (II) when the third component is used.

It is preferable that R_1 each is $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero to 15, q being 1 to 15, and/or that R_3 each is $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero to 15, q being 1 to 15.

It is also preferable that R_1 each is an alkylene having 6 to 9 carbon atoms, being straight or branched, R_2 each is an alkyl having 1 to 4 carbon atoms, being straight or branched, and n is a positive number of 1 to 30 in the formula (I), and/or that R_3 each is an alkylene having 6 to 9 carbon atoms, being straight or branched, R_4 each is an alkyl having 1 to 4 carbon atoms, being straight or branched, and m is a positive number of more than 1 and up to 30 in the formula (II) when the third component is used.

It is preferable to use a compound selected from the group consisting of aliphatic amines and aromatic amines in the step of reacting a polyisocyanate component with the polyol component.

It is preferable to use one or more compound selected from the group consisting of triethanolamine, tolylenediamine (toluylenediamine) and a diamine compound represents by general formula (III):

$$H_2N-R_5-NH_2 \qquad (III)$$

in which R_5 is an alkylene having 2 to 8 carbon atoms, being straight or branched;
as the compound selected from the group consisting of aliphatic amines and aromatic amines.

The amount of the compound selected from the group consisting of aliphatic amines and aromatic amines is preferably 1 to 30 parts by weight based on 100 parts by weight of the total amount of the polyol component.

It is preferable that the polyol component includes 1 to 50 % by weight of the tertiary aminoalcohol having the

formula (I).

Furthermore, it is preferable to to use a polyol having the OH value being 1000 and above as the polyol component together with the tertiary aminoalcohol having the formula (I), and a compound selected from the group consisting of aliphatic amines and aromatic amines in the step of reacting a polyisocyanate component with the polyol component.

It is preferable to use one or more compound selected from the group consisting of H_2O (water), 1,1-dichloro-2,2,2-trifluoroethane and 2-dichloro-2-trifluoroethane as the foaming agent.

When the polyurethane foam is a rigid polyurethane foam, it is preferable that R_1 each is an alkylene having 3 to 9 carbon atoms, being straight or branched, R_2 each is an alkyl having 1 to 4 carbon atoms, being straight or branched, n is an integral number of 2 to 18 in the formula (I).

Furtheremore, it is preferable to use a polyol having the OH value being 1000 and above as the polyol component together with the tertiary aminoalcohol having the formula (I) when the polyurethane foam is a rigid polyurethane foam.

As the polyol having the OH value being 1000 and above, ethyleneglycol and glycerol is more preferable.

It is also preferable that the polyol having the OH value being 1000 and above is used as the polyol component together with the tertiary aminoalcohol having the formula (I), the amount of the tertiary aminoalcohol having the formula (I) is 1 to 50 % by weight based on the total amount of the polyol component, and the amount of the polyol having the OH value being 1000 and above is 1 to 50 % by weight based on the total amount of the polyol component when the polyurethane foam is a rigid polyurethane foam.

It is also preferable that the average OH value of the polyol component is 300 and above when the polyurethane foam is a rigid polyurethane foam.

When the polyurethane foam is a flexible polyurethane foam, it is preferable that R_1 each is an alkylene having 2 to 20 carbon atoms, being straight or branched, an alicyclic alkylene having 4 to 20 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group, an aralkylene having 7 to 20 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being a positive number, R_2 each is an alkyl having 1 to 24 carbon atoms, being straight or branched, or an aralkyl having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group and n is an integral number of 2 to 50 in the formula (I).

When the polyurethane foam is a flexible polyurethane foam, it is also preferable that R_1 each is an alkylene having 6 to 9 carbon atoms, being straight or branched, R_2 each is an alkyl having 1 to 4 carbon atoms, being straight or branched, n is an integral number of 2 to 18 in the formula (I).

It is preferable that the average OH value of the polyol component is 200 and below when the polyurethane foam is a flexible polyurethane foam.

Furtheremore, it is preferable to use H_2O (water) as the foaming agent in amount of 2 to 8 parts by weight based on 100 parts by weight of the total amount of the polyol component when the polyurethane foam is a flexible polyurethane foam.

The forth embodiment of the present invention provides a process for producing a polyurethane foam by spray method, comprising the step of spraying a mixture containing reacting raw materials and a foaming agent and the step of reacting a polyisocyanate component with a polyol component coexisting of a foaming agent, the polyol component comprising, as all or part thereof, a tertiary aminoalcohol having the formula (I):

$$HO-[-R_1-\underset{\displaystyle R_2}{\overset{|}{N}}\!\!\!\!{}^{}-]_n-R_1-OH \qquad (I)$$

in which R_1 each is an alkylene having 2 to 24 carbon atoms, being straight or branched, a cycloalkylene having 3 to 24 carbon atoms, an alicyclic alkylene having 4 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group, an arylene having 6 to 24 carbon atoms, an aralkylene having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being a positive number, R_2 each is an alkyl having 1 to 24 carbon atoms, being straight or branched, an aryl having 6 to 24 carbon atoms or an aralkyl having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group and n is a positive number of more than 1 and up to 50; and H_2O (water) being used as the foaming agent in amount of 2 to 8 parts by weight based on 100 parts by weight of the total amount of the polyol component.

It is preferable that R_1 each is an alkylene having 2 to 20 carbon atoms, being straight or branched, an alicyclic alkylene having 4 to 20 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group, an aralkylene having 7 to 20 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being a positive number, R_2 each is an alkyl having 1 to 20 carbon atoms, being straight or branched, an aralkyl having 7 to 20 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group and n is an integral number of 2 to 50 in the formula (I).

It is also preferable that R_1 each is an alkylene having 6 to 9 carbon atoms, being straight or branched, R_2 each is an alkyl having 1 to 4 carbon atoms, being straight or branched, n is an integral number of 2 to 18 in the formula (I).

Furtheremore it is preferable to use a tertiary aminoalcohol having the formula (II):

$$HO-[-R_3-\underset{\displaystyle R_4}{\overset{}{N}}-]_m-R_4 \qquad (II)$$

in which R_3 each is an alkylene having 2 to 24 carbon atoms, being straight or branched, a cycloalkylene having 3 to 24 carbon atoms, an alicyclic alkylene having 4 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group, an arylene having 6 to 24 carbon atoms, an aralkylene having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being a positive number, R_4 each is an alkyl having 1 to 24 carbon atoms, being straight or branched, an aryl having 6 to 24 carbon atoms or an aralkyl having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group and m is a positive number of more than 1 and up to 50; as a third component in the step of reacting a polyisocyanate component with the polyol component.

The amount of the third component having the formula (II) is preferably 30 % and less by weight based on the total amount of the tertiary aminoalcohol having the formula (I) and the tertiary aminoalcohol having the formula (II) when the third component is used.

It is preferable that R_1 each is $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero to 15, q being 1 to 15, and/or that R_3 each is $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero to 15, q being 1 to 15.

It is also preferable that R_1 each is alkylene having 6 to 9 carbon atoms, being straight or branched, R_2 each is an alkyl having 1 to 4 carbon atoms, being straight or branched, and n is a positive number of more than 1 and up to 30 in the formula (I), and/or that R_3 each is alkylene having 6 to 9 carbon atoms, being straight or branched, R_4 each is an alkyl having 1 to 4 carbon atoms, being straight or branched, and m is a positive number of more than 1 and up to 30 in the formula (II) when the third component is used.

The tertiary aminoalcohols represented by the general formulae (I) and (II) have the following features. Since they have a tertiary amino group in its molecular skeleton, they exhibits a catalytic activity in the reaction of a polyisocyanate compound with an active hydrogen compound. Further, the tertiary aminoalcohol, as such, reacts with an isocyanate group by virtue of the presence of a terminal hydroxyl group and consequently is incorporated in the polyurethane resin skeleton. Further, since the tertiary aminoalcohol represented by the general formula (I) is a diol type, it neither inhibits an increase in the molecular weight of the polyurethane resin nor deteriorates the final properties. Therefore, unlike the conventional tertiary amine catalyst, the tertiary aminoalcohols represented by the general formulae (I) and (II) per se are less liable to give out a bad odor, because it has a terminal hydroxyl group and a molecular weight on a certain level. Therefore, though they are incorporated in the polyurethane resin skeleton, neither the polyurethane resin nor the polyurethane foam gives bad odor, so that no lowering of the commercial value of the product occurs.

In the production of a rigid polyurethane foam, the balance between the gas evolution rate and the resin cure rate in the reaction is important for improving the mold filling. When the gas evolution rate is higher than the resin cure rate, no sufficient amount of gas can be entrapped in the resin and no necessary foam volume is obtained, so that the mold filling becomes poor. On the other hand, when the resin cure rate is higher than the gas evolution rate, the resin viscosity becomes so high that the so-called "liquid flow" lowers, which causes the mold filling of the rigid polyurethane foam to be lowered.

Also when water and trichlorofluoromethane are used in the conventional proportions as a foaming agent, the enhancement in the resin cure rate through a change in the proportion of the polyol, catalyst or the like for the purpose of improving the productivity or the like causes the balance necessary for the mold filling between the gas evolution rate and the resin cure rate to be lost, which lowers the mold filling of the rigid polyurethane foam. By contrast, the use of the tertiary aminoalcohol represented by the general formula (I) as part or the whole of the polyol component, or the use of the tertiary aminoalcohol represented by the general (II) together with the tertiary aminoalcohol represented by the general formula (I) promotes the resinification in an early stage of the reaction and the gasification of trichlorofluoramethane, so that the balance necessary for the mold filling between the gas evolution rate and the resin cure rate is maintained and the mold filling is improved.

In the chlorofluorocarbon-poor formulation wherein the amount of use of trichlorofluoramethane has been reduced, since the amount of use of water is increased, a rapid foam curing reaction lowers the mold filling of the polyurethane foam. In such a formulation, the use of the tertiary aminoalcohol(s) according to the present invention makes it unnecessary to use the conventional catalyst component and further suppresses the reaction of water with the isocyanate group by virtue of the feature of the tertiary aminoalcohol(s) according to the present invention, so that the mold filling

of the polyurethane foam is not impaired.

When 1,1-dichloro-2,2,2-trifluoroethane or 2,2-dichloro-2-fluoroethane is used instead of trichlorofluoromethane, the mold filling lowers due to drawbacks such as a difference in the boiling point between these substances and trichlorofluoromethane, a lowering in the resinification reaction rate due to the dissolution in the resin and an accompanying delay of the evolution of the chlorofluorocarbon gas. By contrast, the use of the tertiary aminoalcohol(s) according to the present invention enhances the resinification reaction rate to prevent the lowering in the mold filling of the polyurethane foam.

In the reaction of the polyol component containing the tertiary aminoalcohol represented by the general formula (I) with the isocyanate, or in the reaction of the tertiary aminoalcohols represented by the general formulae (I) and (II) with the isocyanate in the production of the spray type polyurethane foam, it is possible to complete the reaction through an enhancement in the reaction rate in proportion to the amount of incorporation of the tertiary aminoalcohol(s), and the reaction can proceed at a low temperature of 5°C or below. Since the reaction can sufficiently proceed at such a low temperature, the necessary mechanical properties and bonding strength of the polyurethane foam can be maintained, so that neither peeling nor falling of the thermal insulation layer from the adherend occurs after the spraying.

Further, also in the formulation of the spray type polyurethane foam wherein the amount of use of the chlorofluorocarbons subject to the regulation, such as trichlorofluoromethane, is reduced and water is used in a large amount as a foaming agent, a desired bonding strength can be obtained, and neither peeling nor falling occurs even though the reaction proceed at such a low temperature of 5°C or below.

Further, it has been found that in the production of a flexible polyurethane foam, the use of the tertiary aminoalcohol represented by the general formula (I), or the use of the tertiary aminoalcohol represented by the general (II) together with the tertiary amino alcohol represented by the general formula (I), and the use of a particular amount of water as a foaming agent gives a good foam free from any crack in the production of a flexible hot mold polyurethane foam at a high mold temperature.

Detailed Description of the Invention

In the present invention, the tertiary aminoalcohols represented by the general formulae (I) and (II) may have various structures and molecular weights through variation in the diol and primary amine as the starting materials. A diol having 2 to 24 carbon atoms is used as a diol for the production of the tertiary aminoalcohols, and examples thereof include 1,3-butanediol, 1,4-butanediol, 1,5-pentanediol, 1,6-hexanediol, 1,9-nonanediol, 1,10-decanediol, diethylene glycol, triethylene glycol, tetraethylene glycol, 1,4-cyclohexanedimethanol, 2-ethyl-1,3-hexanediol, 3-methyl-1,5-pentanediol and 1,4-hydroquinone. The primary amine may be a straight-chain or branched aliphatic primary amine or an aralkyl primary amine having 1 to 24 carbon atoms. Examples thereof include methylamine, propylamine, isopropylamine, butylamine, 2-ethylhexylamine, heptylamine, octylamine, decylamine, dodecylamine, cetylamine, stearylamine, docosylamine, oleylamine, benzylamine, phenethylamine and aniline.

The process for producing the tertiary aminoalcohols according to the present invention will now be described in more detail.

In the reaction of a diol with a primary amine to give a tertiary aminoalcohol, a catalyst mainly composed of copper-noble metal, for example, copper-nickel-group VIII platinum element, copper-chromium-group VIII platinum element, copper-zinc-group VIII platinum element, copper-manganese-group VIII platinum element, copper-iron-group VIII platinum element and copper-cobalt-group VIII platinum element is used, and the reaction system is stirred at a temperature of 150 to 250°C under atmospheric or elevated pressure while continuously or intermittently removing water formed by the reaction in the presence of the above-described catalyst outside the reaction system.

In this case, the diol may be continuously added during the reaction, originally fed or fed in portions in a particular amount.

When the primary amine is a gas, it may be continuously or intermittently blown during the reaction. Alternatively, a predetermined amount of the primary amine may be fed at once under pressure. On the other hand, when the primary amine is a liquid, it may be continuously fed, or a predetermined amount thereof may be originally fed.

The molar ratio of the amine to the diol should be 0.7 or more, preferably 1 or more. In the case of a gaseous amine, the gaseous amine of excess volume feeds together with hydrogen gas and they may be recovered and circulated for reuse.

In the process for producing the tertiary aminoalcohol represented by the general formula (I) according to the present invention, it is preferred to remove water formed by the reaction of the diol with the primary amine outside the reaction system. When the formed water is not removed outside the reaction system, the catalytic activity and and selectivity of the resulting tertiary aminoalcohol often lower. For example, when the reaction is conducted without removal of the formed water, the yield of the intended tertiary aminoalcohol often lowers due to an increase in the amount of the disproportionation product.

The tertiary aminoalcohol represented by the general fomula (II) is formed as the disproportionation product of

the tertiary aminoalcohol represented by the general formula (I), and it is also possible to use a mixture containing these tertiary aminoalcohols represented by the general formulae (I) and (II). Therefore, it is not always necessary to remove the formed water as far as the amount of the formed water is such that the amount of the tertiary aminoalcohol represented by the general formula (II) as the disproportionation product of the tertiary aminoalcohol represented by the general formula (I) is within the limits of giving the intended polyurethane when the mixture containing these tertiary aminoalcohols represented by the general formulae (I) and (II) is used to product the polyurethane.

Although the removal of the formed water may be intermittently or continuously conducted during the reaction and may be arbitrarily removed so that the formed water does not exist in the reaction system for a long period of time, it is preferred to continuously remove the formed water. More specifically, it is a common practice to introduce a suitable amount of hydrogen gas into the reaction system during the reaction to distill off the formed water together with hydrogen gas. It is also possible to concentrate and separate the formed water by means of a condenser and to circulate the hydrogen gas for reuse. Further, a suitable solvent may be added during the reaction to distill off the formed water in the form of an azeotrope with this solvent. Also an inert solvent may be added for the purpose of lowering the viscosity of the reaction product system.

In the present invention, although a catalyst which has been previously reduced with hydrogen gas may be used, it is preferred that the catalyst may be reduced by putting a catalyst before reduction into a reactor together with a diol as a starting material and raising the reaction temperature while introducing hydrogen gas or a mixture of hydrogen gas with a gaseous amine when the amine to be reacted is a gaseous one.

The tertiary aminoalcohol used in the present invention has a structure represented by the general formula (I). As described above, depending upon the reaction conditions, the tertiary aminoalcohol may be prepared in the form of a mixture of a diol represented by the general formula (I) with a mono-ol represented by the general formula (II). In general, the diol and mono-ol are obtained in a molar ratio of the diol to the mono-ol in the range of from 70/30 to 100/0.

In the general formula (I), the R_1 each is an alkylene having 2 to 24 carbon atoms, being straight or branched, a cycloalkylene having 3 to 24 carbon atoms, an alicyclic alkylene having 4 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group, an arylene having 6 to 24 carbon atoms, an aralkylene having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being a positive number, preferably a straight-chain or branched alkylene group having 6 to 9 carbon atoms. The R_2 each is an alkyl having 1 to 24 carbon atoms, being straight or branched, an aryl having 6 to 24 carbon atoms or an aralkyl having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group. The term "aralkyl" as used herein is intended to mean an alkyl group having an aromatic ring, such as a benzyl or phenetyl group. The above-described aralkylene is a divalent group formed by removing one hydrogen atom from the aralkyl. The R_2 each is preferably an alkyl having 1 to 4 carbon atoms, being straight or branched, particularly preferably a methyl group.

When R_1 each is $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, it is preferable that p is zero to 15 and/or q is 1 to 15, and it is more preferable that p is zero to 10 and/or q is 1 to 10.

When R_1 each is an alicyclic alkylene or an aralkylene, the alkylene group in the alicyclic alkylene or an aralkylene has 1 to 3 carbon atoms preferably. The alicyclic group in the alicyclic alkylene and the aryl group in the aralkylene may be substituted with a lower alkyl such as methyl and ethyl, and so on.

When R_1 each is a cycloalkylene or an arylene, it may be substituted with a lower alkyl such as methyl and ethyl, and so on.

When R_2 each is an aralkyl, the alkylene group in the aralkyl has 1 to 3 carbon atoms preferably. The aryl group in the aralkyl may be substituted with a lower alkyl such as methyl and ethyl, and so on.

When R_2 each is an aryl, it may be substituted with a lower alkyl such as methyl and ethyl, and so on.

The average degree of polymerization, n, is more than 1 and up to 50, preferably more than 1 and up to 30, particularly preferably 2 to 18.

When the number of carbon atoms in the R_1 exceeds 24 and n is larger than 50, the resultant tertiary aminoalcohol (s) has an increased molecular weight and an increased viscosity depending upon the number of carbon atoms and structure of the R_2. On the other hand, when the number of carbon atoms of the R_1 is smaller than 2 and n is smaller than 1, the content of the tertiary amino group in the molecular skeleton becomes so low that no expected catalytic property can be obtained.

In the general formula (II), the R_3 each is an alkylene having 2 to 24 carbon atoms, being straight or branched, a cycloalkylene having 3 to 24 carbon atoms, an alicyclic alkylene having 4 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group, an arylene having 6 to 24 carbon atoms, an aralkylene having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being a positive number, preferably a straight-chain or branched alkylene group having 6 to 9 carbon atoms. The R_4 each is an alkyl having 1 to 24 carbon atoms, being straight or branched, an aryl having 6 to 24 carbon atoms or an aralkyl having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group. The R_4 each is preferably an alkyl having 1 to 4 carbon atoms, being straight or branched, particularly preferably a methyl group.

When R_3 each is $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, it is preferable that p is zero to 15 and/or q is 1 to 15, and it is more

preferable that p is zero to 10 and/or q is 1 to 10.

When R_3 each is an alicyclic alkylene or an aralkylene, the alkylene group in the alicyclic alkylene or an aralkylene has 1 to 3 carbon atoms preferably. The alicyclic group in the alicyclic alkylene and the aryl group in the aralkylene may be substituted with a lower alkyl such as methyl and ethyl, and so on.

When R_3 each is a cycloalkylene or an arylene, it may be substituted with a lower alkyl such as methyl and ethyl, and so on.

When R_4 each is an aralkyl, the alkylene group in the aralkyl has 1 to 3 carbon atoms preferably. The aryl group in the aralkyl may be substituted with a lower alkyl such as methyl and ethyl, and so on.

When R_4 each is an aryl, it may be substituted with a lower alkyl such as methyl and ethyl, and so on.

The average degree of polymerization, m, is more than 1 and up to 50, preferably more than 1 and up to 30, particularly preferably 2 to 18.

When the number of carbon atoms in the R_3 exceeds 24 and m is larger than 50, the resultant tertiary aminoalcohol (s) has an increased molecular weight and an increased viscosity depending upon the number of carbon atoms and structure of the R_4. On the other hand, when the number of carbon atoms of the R_3 is smaller than 2 and n is smaller than 1, the content of the tertiary amino group in the molecular skeleton becomes so low that no expected catalytic property can be obtained.

Thus, the selection of the content of the tertiary amino group in the molecular skeleton, molecular weight, and the molecular weight and structure of the side chain in such a range as to satisfy the performance requirement of the polyol gives tertiary aminoalcohol represented by the general formula (I) having various catalytic properties in conformity with the required reactivity, so that it becomes possible to produce a rigid polyurethane foam having various properties substantially without the necessity for using any catalyst component.

The selection of the content of the tertiary amino group in the molecular skeleton, molecular weight, and the molecular weight and structure of the side chain gives tertiary aminoalcohol represented by the general formula (II) having various catalytic properties in conformity with the required reactivity, so that it becomes possible to produce a rigid polyurethane foam having various properties substantially without the necessity for using any catalyst component.

In the present invention, the tertiary aminoalcohol represented by the general formula (I) may be used as a mixture containing two and more tertiary aminoalcohols represented by the general formula (I), and the tertiary aminoalcohol represented by the general formula (II) may be used as a mixture containing two and more tertiary aminoalcohols represented by the general formula (II), similarly.

In the present invention, the tertiary amino alcohol represented by the general formula (I) may be used as a polyol component together with other polyol in any arbitrary proportion. Generally known polyester polyols, polyether polyols, etc., used for the production of polyurethane foam may be used as the polyol component with the tertiary amino alcohol represented by the general formula (I). Examples thereof include ordinary polyester polyols produced from a dibasic acid and a polyhydric alcohol and polyether polyols prepared by adding ethylene oxide and/or propylene oxide to a glycol such as ethylene glycol or propylene glycol, a polyhydric alcohol such as glycerol, pentaerythritol, trimethylolpropane, sorbitol or sucrose, and ammonia, triethanolamine or aniline or a polyamine such as ethylenediamine, diethylenetriamine, aminoethylpiperazine, triethylenediamine, 1,3-propanediamine or isophoronediamine. The above-described polyols may be used alone or in the form of a mixture of two or more of them.

The combined use of a compound selected from among polyhydric alcohols having a hydroxyl value of 1000 or more as the polyol component, and a compound selected from aliphatic amines and aromatic amines serves to provide a rigid polyurethane foam excellent in mold filling as well as in the thermal insulation and low temperature dimensional stability.

Examples of the polyhydric alcohol include aromatic amine polyols, sugar-type polyether polyols and glycerol-type polyether polyols. Ethylene glycol and glycerol are particularly preferred. The amount of use of the polyfunctional alcohols is preferably 1 to 50% by weight based on the whole amount of the polyol component.

In the present invention, the tertiary aminoalcohol represented by the general formula (I) is used as part or the whole of the polyol component, and may be used in combination with other polyol in any proportion. The amount of use of the tertiary aminoalcohol is preferably 1 to 50% by weight, still preferably 1 to 30% by weight based on the whole amount of the polyol component.

Examples of the polyisocyanate compound useable in the present invention include aromatic, aliphatic and alicyclic polyisocyanates having two or more isocyanate groups, mixtures of two or more of them, and modified polyisocyanates prepared by modifying these compounds. More specific examples thereof include polyisocyanates such as tolylene diisocyanate, diphenylmethane diisocyanate, polymethylene polyphenyl polyisocyanate (crude MDI), xylilene diisocyanate, isophorone diisocyanate and hexamethylene diisocyanate, and modified polyisocyanates thereof, for example, carbodiimide-modified products, biuret-modified products, dimers and trimers, and further isocyanate-terminated prepolymers prepared from the above-described polyisocyanate and a compound having active hydrogen(s).

The foaming agent is at least one selected from the group consisting of water, trichlorofluoromethane, 1,1-dichloro-2,2,2-trifluoroethane and 2,2-dichloro-2-fluoroethane preferably. In particular, in the case of the production of a flexible

polyurethane foam, water is used as the foaming agent. If necessary, methylene chloride, pentane, n-hexane, etc., may be used in combination with the foaming agent for the purpose of reducing the amount of use of trichlorofluoromethane.

In the present invention, in addition to the above-described polyisocyanate component and polyol component, catalysts, surfactants and/or foam stabilizers, colorants, fire retardants and stabilizers may be used according to need. The kind and amount of addition of the additives may be those commonly used in the art.

Although the use of the tertiary aminoalcohol represented by the general formula (I) according to the present invention as the whole or at least part of the polyol component makes it substantially unnecessary to use the catalyst component, it is also possible to use a conventional catalyst for the purpose of further enhancing the moldability and workability depending upon the applications. There is no particular limitation on the catalyst used for this purpose, and conventional amine catalysts and metallic catalysts may be used. These catalysts may be used alone or in the form of a mixture of two or more of them in combination with the tertiary aminoalcohol represented by the general formula (I).

Further, in the present invention, a crosslinking agent can be used according to need. Examples of the crosslinking agent include monomeric glycols such as ethylene glycol, propylene glycol, diethylene glycol and 1,4-butanediol, alkanolamines such as diethanolamine and triethanolamine, aliphatic polyamines such as ethylenediamine and diethylenetriamine, and aromatic diamines such as 4,4-diphenylmethanediamine.

In the process for producing the polyurethane according to the invention, A mixture which includes above-mentioned polyol component as main component and B mixture which includes above-mentioned polyisocyanate compound as main component are mixed and reacted. Other components excepting for the polyolcomponent and the isocyanate compound are included in A mixture or B mixture. The reaction condition does not limited.

In the process for producing the polyurethane foam according to the invention, A mixture which includes above-mentioned polyol component as main component and B mixture which includes above-mentioned polyisocyanate compound as main component are mixed and reacted. The foaming agent is included in A mixture or B mixture, preferably in A mixture. Other components excepting for the polyol component and the isocyanate compound are included in A mixture or B mixture. The reaction condition does not limited.

In the process for producing the spray type rigid polyurethane foam according to the invention, A mixture which includes above-mentioned polyol component as main component and B mixture which includes above-mentioned polyisocyanate compound as main component are mixed, sprayed and reacted. The foaming agent is included in A mixture or B mixture, preferably in A mixture. Other components excepting for the polyol component and the isocyanate compound are included in A mixture or B mixture. The reaction condition does not limited.

Brief Description of the Drawing

Fig. 1 is a chart showing an infrared absorption spectrum of a polyurethane prepared in Example 1.

Examples

The present invention will now be described in more detail with reference to the following Examples, though it is not limited to these Examples only. In the Examples, "part" is by weight unless otherwise specified.

<Production Examples of Tertiary Aminoalcohol>

Referential Example A

A 1-ℓ flask equipped with a condenser and a separator for formed water was charged with 160 g of 1,6-hexanediol and 24 g (4% by weight based on diol) of a Cu/Ni/Pd catalyst and purged with nitrogen while stirring, and heating was started. When the temperature in the system reached 100°C, hydrogen gas was blown into the system at a flow rate of 10 ℓ/hr (by flow meter) and the temperature was then raised to 180°C. At that temperature, a gaseous mixture of monomethylamine and hydrogen was blown into the system at a flow rate of 40 ℓ/hr. The progress of the reaction was traced by the amine value and the hydroxyl value. The reaction was conducted for 4 hr. After the completion of the reaction, the catalyst was separated by filtration to give a viscous liquid having a light brown color.

Referential Example B

A reaction was conducted for 4 hr under the same condition as that of the Referential Example A, except that the blowing flow rate of hydrogen and that of the gaseous mixture of monomethylamine with hydrogen were 5 ℓ/hr and 35 ℓ/hr, respectively.

Referential Example C

A reaction was conducted for 40 hr under the same condition as that of the Referential Example B, except that n-butylamine was used as the amine, the reaction temperature was 185°C and n-butylamine was added in drops to the reaction system.

Referential Example D

A reaction was conducted for 30 hr under the same condition as that of the Referential Example B, except that benzylamine was used as the amine to be added at once to the reaction system.

Referential Example E

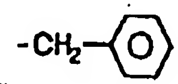
A reaction was conducted for 8 hr under the same condition as that of the Referential Example B, except that the reaction temperature was 210°C, 1,9-nonanediol was used as the alcohol and the catalyst was used in an amount of 2% by weight.

Referential Example F

A reaction was conducted for 8 hr under the same condition as that of the Referential Example B, except that the reaction temperature was 210°C and triethylene glycol was used as the alcohol.

The properties of the tertiary aminoalcohols prepared in the Referential Examples A to F are given in Table 1.

Table 1

			A	B	C	D	E	F
tert. amino-alcohol	$-R_1-$, $-R_3-$ *		$-C_6H_{12}-$	do.	do.	do.	$-C_9H_{10}-$	$-(C_2H_4O)_2(C_2H_4)-$
	$-R_2$, $-R_4$ *		$-CH_3$	do.	$-C_4H_9$		$-CH_3$	do.
	formula (I)	n	4.1	3.8	9.2	3.9	13.5	3.3
		average molecular weight	580	550	1550	850	2260	560
	formula (II)	m	-	3.5	8.0	3.5	11.5	3.0
		average molecular weight	-	430	1320	770	1750	430
	(I)/(II) molar ratio		100/0	90/10	95/5	90/10	98/2	90/10

Note: *: R_1, R_2, R_3 and R_4 groups are those of a tertiary amino alcohol represented by the formula (I) or (II). The molecular weight is a value determined by the conventional gel permeation chromatography.

Examples 1 to 8 and Comparative Examples 1 and 2

The reactivities of the tertiary aminoalcohols A to E according to the present invention, comparative general-purpose polyol and mixtures of the tertiary aminoalcohol according to the present invention and comparative general-purpose polyol were measured by the following method.

50 ml of a 0.1533 mol/ℓ benzene solution of each of the tertiary aminoalcohols listed in Table 1 and 50 ml of 0.1533 mol/ℓ benzene solution of TDI-100 (NCO/OH molar ratio : 1.05) (a product of Mitsui Toatsu Chemicals, Inc.) were put in a 200 ml-conical flask equipped with a ground stopper and the flask was allowed to stand in a thermostatic chamber at 30°C to conduct a reaction. The reaction was traced based on the percentage reduction of the concentration of the isocyanate group in the reaction system.
Specifically, sampling was conducted with a 10-ml pipette every one hour until 4 hr after the initiation of the reaction. The reaction mixture was added to 5 ml of a 25 g/ℓ n-butylamine-dioxane solution and the mixture was sufficiently shaken and titrated with a 0.2 N hydrochloric acid-alcohol solution. The concentration of the isocyanate group remaining in the reaction mixture was determined from the difference between the amount of the consumed hydrochloric acid and the amount of hydrochloric acid consumed in 5 ml of a blank solution.

In this case, when the concentration of the isocyanate group reduced by the reaction is expressed by Y, 1/Y is proportional to the reaction time, t. The 1/Y value two hr after the initiation of the reaction is given in Table 2.

An infrared absorption spectrum of polyurethane produced in Example 1 is shown in Fig. 1.

Table 2

component (pt. by wt.)		Ex. No. 1	2	3	4	5	6	7	8	Comp. Ex. No. 1	2
tert. amino-alcohol	A	100	50	10							
	B				100						
	C					100					
	C						100				
	D							100			
	E								100		
general-purpose polyol*1			50	90						100	100
catalyst*2											2
1/Y		158	80	25	160	40	30	135	80	14	22

Note) *1: Exenol 2020, a product of Asahi Glass Co., Ltd.

*2: N,N,N,N-tetramethylhexamethylenediamine (Kao Lizer No. 1), a product of Kao Corp.

Examples 9 to 16 and Comparative Examples 3 and 4

The panel filling property when polyurethane foams were molded through the use of each of the tertiary aminoalcohols A to F according to the present invention and general-purpose polyol A was measured by the following method.

Starting materials for the production of a polyurethane foam were mixed with each other according to the formulation specified in Table 3, and urethane foaming was conducted by a conventional procedure. Specifically, each of the polyols, water, a surfactant, a catalyst (N,N,N,N-tetramethylhexamethylenediamine, Kao Lizer No. 1), a foaming agent and a polyisocyanate which were kept at 20°C were mixed with each other, and the mixture was stirred and poured into a

panel for measuring the panel filling to mold a polyurethane foam.

The following polyol mixture was used as the general-purpose polyol A:

aromatic polyether polyol (OHV : 450), a product of Asahi Olin Ltd.	70 parts
sugar polyether polyol (OHV : 530), a product of Sumitomo Bayer Urethane Co., Ltd.	20 parts
glycerin polyether polyol (OHV : 235), a product of Mitsui Toatsu Chemical, Inc.	10 parts

The panel was used after adjusting the temperature of an inverted L-shaped panel having a size of 450 x 500 x 35 mm (vertical part) and 450 x 450 x 35 mm (horizontal part) to 40°C.

The cream time (hereinafter referred to as "CT") and gel time (hereinafter referred to as "GT") in the molding of a polyurethane foam and the panel filling property of the polyurethane form were evaluated. The term "CT" used herein is intended to mean a time taken from the initiation of the stirring to the initiation of the foaming reaction, while the term "GT" a time taken for the resin to elongate in stringy form when a tip of a sharp-edged material is brought into contact with the surface of the urethane foam and then separated therefrom.

The panel filling property is expressed by the length (cm) of the molded article when a given amount (350 g) of stirred urethane starting materials is poured into the panel.

The results are given in Table 3.

Table 3

			Ex. No.								Comp. Ex. No.	
			9	10	11	12	13	14	15	16	3	4
component (pt. by wt.)	tert. amino-alcohol	A	20	10	5							
		B				10						
		C					10					
		D						10				
		E							10			
		F								10		
	polyol A		80	90	95	90	90	90	90	90	100	100
	water		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	R-123*1		50	←	←	←	←	←	←	←	←	←
	L-5340*2		2	←	←	←	←	←	←	←	←	←
	catalyst		—	←	←	←	←	←	←	←	3	4
	C-MDI*3		index 105	←	←	←	←	←	←	←	←	←
reactivity	CT		7	9	13	9	11	13	13	10	12	9
	GT		35	40	52	38	46	54	55	52	57	45
	panel filling		76	76	76	76	75	76	76	78	71	69

Note) *1: silicone surfactant (a product of Nippon Unicar Co., Ltd.),

*2: 1,1,1-trifluorodichloroethane,

*3: Crude MDI, a product of Mitsui Toatsu Chemicals, Inc.)

Examples 17 to 27 and Comparative Examples 5 to 9

Rigid polyurethane foams were producted and their foaming properties were evaluated. Each formulation specified in Table 4 and other components (a foam stabilizer and a polyisocyanate component) were mixed and urethane foaming was conducted by a conventional procedure. In this case, 1.5 parts of L-5340, a product of Nippon Unicar Co., Ltd., was used as a foam stabilizer, while a mixture of tetramethylhexamethylenediamine (Kao Lizer No. 1), a product of Kao Corp., with pentamethyldiethylenetriamine (Kao Lizer No. 3) in a weight ratio of 3 : 1 was used as a catalyst. TR-50BX (wt.% of isocyanate : 30.7) was used in an NCO to OH ratio of 1.05 as the polyisocyanate component.

The free density and mold filling property were measured by the following method:

(1) free density:	density obtained when the foaming was conducted in a veneer mold having an internal dimension of 150 x 150 x 200 mm, kg/m^3.
(2) mold filling:	length of a molded article obtained when 350 g of the starting material was poured into an inverted L-shaped aluminus mold having a temperature adjusted to 40°C, cm/350 g.

The results are given in Table 4.

Table 4

Formulation		Comp. Ex. No.					Ex. No.										
		5	6	7	8	9	17	18	19	20	21	22	23	24	25	26	27
polyol A		100	100	100	100	100	90	80	90	60	70	90	80	90	90	90	90
tert. amino-alcohol	A						10	20									
	B								10								
	C									40							
	D										30						
	E											10					
	F												20				
foaming agent	water	1.5	1.5	4.0	2.7	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	4.0	1.5	2.7	1.5
	R-11 *	40	40	20			40	40	40	40	40	40	40	20			
	R-123				40										48	40	
	R-141b **					35											35
catalyst		2	1.8	2	3	2											
free density (kg/m^3)		22.5	21.0	23.2	22.1	22.5	22.6	22.0	22.8	22.7	22.9	22.0	23.0	23.9	22.3	21.8	22.0
mold filling (cm)		80	84	75	70	70	85	88	86	84	84	85	87	79	81	78	75

Note) * trichlorofluoromethane

** 2,2-dochloro-2-flloroethane

Examples 28 to 55 and Comparative Examples 10 to 17

Rigid polyurethane foams were producted and their properties were evaluated. Starting materials for the production of a polyurethane foam, each formulation specified in Tables 5 and 6 and a polyisocyanate component TR-50BX (wt. % of isocyanate : 30.7), were mixed and urethane foaming was conducted by a conventional procedure. Specifically, polyol component(s), a foaming agent, a foam stabilizer, a catalyst and a polyisocyanate were mixed with each other, stirred and poured into a mold having a size of 20 x 20 x 5 cm and kept at 40°C, and demolding was conducted 10 min after the pouring to prepare a rigid polyurethane foam, which was used as a sample for various evaluations.

Each rigid polyurethane foam thus prepared was stored at -30°C for 24 hr to measure the percentage dimensional change. Further, the foam was cut into a size of 18 x 18 x 2.5 cm to measure the thermal conductivity. In the Tables 5 and 6, the amount of resin breakage refers to the amount of a resin determined in the measurement of the friability as one measure of the adhesiveness by the following method. A stirred rigid polyurethane foam starting materials were poured into the above-described mold kept at 40°C, and demolded 5 min after the pouring, and the measured amount of the resin adherent to the mold was defined as the amount of resin breakage. The results are given in Tables 5 and 6.

In this case, general-purpose polyol A used was the same as Table 3. 1.5 parts of L-5340, a product of Nippon Unicar Co., Ltd., was used as a foam stabilizer, while tetramethylhexamethylenediamine (Kao Lizer No. 1), a product of Kao Corp., was used as a catalyst in an amount specified in Tables 5 and 6. TR-50BX (wt.% of isocyanate : 30.7), a product of Mitsui Toatsu Chemicals, Inc., was used in an NCO to OH ratio of 1.05 as the polyisocyanate component. The glycerin used as a polyol component was a purified one (OHV : 1830), a product of Kao Corp. The tolylenediamine (toluylenediamine) used as an aromatic amine was a product of Mitsui Toatsu Chemicals, Inc.. The triethanolamine used as an aliphatic amine was a product of Mitsui Toatsu Chemicals, Inc..

Table 5

			Comp. Ex. No.				Ex. No.													
			10	11	12	13	28	29	30	31	32	33	34	35	36	37	38	39	40	41
starting material compsn. (pt. by wt.)	tert. amonoalcohol	A			10		10	20						10	60	10	10	10	10	10
		B							10											
		C								15										
		D									30									
		E										40								
		F											50							
	polyol A		100	100	90	90	80	70	80	75	60	50	40	70	30	50	80	85	80	80
	glycerin					10	10	10	10	10	10	10	10	20	10	40	5			5
	tolylenediamine																5	5		
	triethanolamine																		10	5
	Kao Lizer No. 1		3	3																
	foaming agent (L-5340)		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	R-11		40																	
	R-123			48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
property of foam	density (kg/m³)		38.0	39.1	39.2	39.3	39.0	40.0	39.5	39.9	39.1	38.0	39.7	39.5	39.0	38.8	39.0	38.8	39.1	30.0
	thermal conductivity x 10⁻⁴ (kcal/hm°C)		130	145	140	141	135	134	135	135	133	134	133	133	133	132	133	134	133	133
	low temp. dimensional stability (%; -30°C, 24 hr)		-1.5	-38.4	-43.1	-1.0	-1.5	-1.8	-1.3	-1.9	-2.0	-2.2	-2.4	-0.5	-3.5	-0.4	-2.0	-2.9	-3.1	-2.5
	amt. of resin breakage (g; 40°C, 5 min)		0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.4	0.0	1.0	1.0	1.1	0.5	0.0

Table 6

			Comp. Ex. No.				Ex. No.													
			14	15	16	17	42	43	44	45	46	47	48	49	50	51	52	53	54	55
starting material compsn. (pt. by wt.)	tert. aminoalcohol	A			10		10	20						10	60	10	10	10	10	10
		B							10											
		C								15										
		D									30									
		E										40								
		F											50							
	polyol A		100	100	90	90	80	70	80	75	60	50	40	70	30	50	80	85	80	80
	glycerin					10	10	10	10	10	10	10	10	20	10	40	5			5
	tolylenediamine																5	5		
	triethanolamine																		10	5
	Kao Lizer No. 1		3	3																
	foaming agent (L-5340)		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	water		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	R-11		40																	
	R-123			48	48	48	48	48	48	48	48	48	48	48	48	48	44	44	44	44
property of foam	density (kg/m³)		24.0	24.1	24.3	23.5	24.1	25.1	24.1	24.3	24.0	23.7	23.9	24.4	24.8	24.3	23.9	24.3	24.1	24.0
	thermal conductivity x 10^{-3} (kcal/hm°C)		137	153	148	146	141	140	141	140	139	139	138	139	138	139	140	141	141	130
	low temp. dimensional stability (%: -30°C, 24 hr)		-0.6	-23.0	-28.1	-0.5	-0.7	-0.9	-0.9	-1.1	-1.2	-1.4	-1.5	-0.3	-1.9	-0.3	-2.0	-3.0	-3.5	-2.0
	amt. of resin breakage (g: 40°C, 5 min)		0.5	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.4	0.3	0.2	0.8	0.1	2.9	2.4	2.0	0.8	0.9

Examples 56 to 61

Starting materials for the production of a polyurethane foam, each formulation specified in Table 7 and a polyisocyanate component TR-50BX (wt.% of isocyanate : 30.7), were mixed, and urethane foaming was conducted in the same manner as that described above to give a rigid polyurethane foam. Each of the rigid polyurethane foams was used as the sample for various evaluations. The results are given in Table 7.

In Table 7, polyol A and L-5340 were the same as those described above. Ethylene glycol used as a polyol component was a first-grade reagent (OHV : 1810) of Katayama Chemical Industry Corp.. 1,6-Hexanediamine was a first-grade reagent of Katayama Chemical Industry Corp.. TR-50BX (wt.% of isocyanate : 30.7), a product of Mitsui Toatsu Chemicals, Inc., was used in an NCO to OH ratio of 1.05 as the polyisocyanate component.

Table 7

			Ex. No.					
			56	57	58	59	60	61
starting material compsn. (pt. by wt.)	tert. aminoalcohol	A	10		10	10		
		B		10				
		C			10			
		D				10		
		E					20	
		F						30
	polyol A		80	75	65	65	65	57
	ethylene glycol		10	10	10	10	10	10
	1,6-hexanediamine		0	5	5	5	5	3
	foaming agent (L-5340)		1.5	1.5	1.5	1.5	1.5	1.5
	water		1.5	1.5	1.5	1.5	1.5	1.5
	R-123		48	48	48	48	48	48
property of foam	density (kg/m^3)		24.2	24.9	24.8	24.3	24.3	25.5
	thermal conductivity x 10^{-4} (kcal/hm°C)		141	141	140	142	141	141
	low temp. dimensional stability (%; -30°C, 24 hr)		-1.3	-1.4	-2.0	-2.1	-0.5	-.07
	amt. of resin breakage (g; 40%, 5 min)		0.3	0.4	0.3	0.4	0.4	0.4

Comparative Examples 18 and 19

Foaming was conducted by the following method according to each formulation of the conventional spray type rigid polyurethane foam as specified in Table 8.

Among the blending materials listed in the Table 8, the starting materials except for Crude MDI were preliminarily mixed with each other and kept at 5°C, and Crude MDI adjusted to a temperature of 5°C was reacted with a predetermined amount of the preliminarily mixed components (mixture of the starting materials except for Crude MDI) by hand mixing foaming to measure the reaction rate (CT, GT and RT) and mechanical properties of the resultant foams.

The self adhesive bonding strength was measured according to the method prescribed in JIS A 9526. Specifically, a sample was prepared by preliminarily mixing staring materials except for Crude MDI with each other and maintaining the mixture at 5°C, subjecting the Crude MDI adjusted to a temperature of 5°C and a specified amount of the preliminarily mixed components to hand mixing, applying the liquid mixture to a veneer kept at 5°C, and subjecting the resulting coating to foam curing. The environmental temperature in the foaming process was maintained at 5°C.

The results are given in Table 9.

Examples 62 to 65

Foaming was conducted according to each formulation specified in Table 8 in the same manner as that of the Comparative Examples 18 and 19 through the use of the tertiary aminoalcohols A and B of the present invention prepared in the Referential Examples to measure various properties of the polyurethane foams.

The results are given in Table 9.

Example 66 and Comparative Example 20

A foaming test was conducted a low temperature (0°C). The foaming was conducted under the same condition as that of the Comparative Example 18 and Example 54. The temperature of the starting materials was kept at 0°C, and the temperature of the sample for the self adhesive bonding strength and the room temperature as well were kept at 0°C. The results are given in Table 9.

Table 8

	Ex. No.					Comp. Ex. No.		
	62	63	64	65	66	18	19	20
general-purpose polyol B	24 pts.	←	←	←	←	30	←	←
general-purpose polyol C	56	←	←	←	←	70	←	←
tert. aminoalcohol A	20	←	0	←	20	0	←	←
tert. aminoalcohol B	0	←	20	←	0	0	←	←
amine catalyst (Kao Lizer No. 1)	2	←	←	←	←	2	←	←
metal catalyst (lead octanoate, Pb: 25%)	0.5	←	←	←	←	←	←	←
water	3	6	3	6	3	3	6	3
silicone foam stabilizer	1	←	←	←	←	←	←	←
Flon-11	30	10	30	10	30	30	10	30
Crude MDI (NCO: 31%)	index 105	←	←	←	←	←	←	←

Note: general-purpose poyol B: amine polyether polyol (OHV : 450)
general-purpose poyol C: sucrose polyether polyol (OHV : 450)

Table 9

	Ex. No.					Comp. Ex. No.		
	62	63	64	65	66	18	19	20
reaction temp. (°C)	5	←	←	←	0	5	←	0

Table 9 (continued)

		Ex. No.					Comp. Ex. No.		
		62	63	64	65	66	18	19	20
reactivity	CT (sec)	5	4	5	4	6	5	4	6
	GT (sec)	15	14	14	13	18	14	13	18
	RT (sec)	18	16	17	15	21	17	15	21
foam density (g/ℓ)		24.3	24.2	24.1	24.3	24.7	24.1	24.3	24.7
self adhesive bonding strength (kg·f/cm²)		1.5	1.3	1.5	1.3	1.2	1.5	1.3	1.2
compressive strength (kg/cm²)		0.8	0.7	0.8	0.7	0.7	0.8	0.7	0.7

Examples 67 to 69

According to each formulation specified in Table 10, glycerin polyether polyol, tertiary aminoalcohols prepared in the Referential Examples, water and a silicone foam stabilizer were preliminarily mixed with each other, and the temperature of the mixture was adjusted to 25°C.

Then, stannous octanoate was added thereto and the mixture was stirred for 5 sec. TDI-80 (2,4-tolylene diisocyanate/2,6-tolylene diisocyanate : 80/20) adjusted to a temperature of 25°C was immediately added thereto and the mixture was further stirred for 5 sec and poured into an aluminum mold having a size of 30 x 30 x 7 cm kept at 60°C. The mold was placed in an oven set at 160°C, and curing was conducted for 10 min, thereby preparing a flexible mold polyurethane foam. The results are given in Table 10.

Comparative Example 20

According to the formulation specified in Table 10, foaming was conducted under the same condition as that of the Example 59, except that glycerin polyether polyol alone was used as a polyol. The results are given in Table 10.

Table 10

		Ex. 67	Ex. 68	Ex. 69	Comp. Ex. 20
formulation (g)	glycerin polyether polyol (OHV: 56)	142.5	145.5	142.5	150
	tert. amonoalcohol A	7.5	4.5	0	-
	tert. amonoalcohol B	0	0	7.5	-
	water	6.8	6.8	6.8	6.8
	silicone foam stabilizer	2.3	1.5	2.3	1.5
	stannous octanoate	0.1	0.1	0.1	0.1
	KL-31*1	-	-	-	0.4
	KL-21*2	-	-	-	0.4
	T-80*3	index 100	index 100	index 100	index 100
mold temp. during pouring (°C)		60	60	60	60
state of foam	surface	good	good	good	peeling
	inside	good	good	good	cracking

Table 10 (continued)

		Ex. 67	Ex. 68	Ex. 69	Comp. Ex. 20
properties of foam	overall density (g/ℓ)	29.0	29.1	29.0	32.2
	hardness (F type)	67	64	66	67
	tensile strength (kg/cm^2)	1.62	1.58	1.57	1.52
	tear strength (kg/cm^2)	0.75	0.78	0.76	0.75
	elongation (%)	149	151	158	155
	permanent compression set (50%, 70°C x 22 hr)	4.9	4.8	4.8	4.5
	gas permeability (cc/cm^2/sec)	16.7	15.3	16.0	11.6

Note)
*1: 33% solution of triethylenediamine in dipropylene glycol
*2: N-ethylmorpholine
*3: tolylene diisocyanate (2,4-/2,6-isomer : 80/20)

Claims

1. A process for producing a polyurethane, comprising the step of reacting a polyisocyanate component with a polyol component, the polyol component comprising, as all or part thereof, a tertiary aminoalcohol having the formula (I):

$$HO-[-R_1-\overset{\displaystyle R_2}{\overset{|}{N}}-]_n-R_1-OH \qquad (I)$$

in which R_1 each is an alkylene having 2 to 24 carbon atoms, being straight or branched, a cycloalkylene having 3 to 24 carbon atoms, an alicyclic alkylene having 4 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group, an arylene having 6 to 24 carbon atoms, an aralkylene having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being a positive number, R_2 each is an alkyl having 1 to 24 carbon atoms, being straight or branched, an aryl having 6 to 24 carbon atoms or an aralkyl having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group and n is a positive number of more than 1 up to 50 on the average.

2. The process according to claim 1, wherein R_1 each is an alkylene having 6 to 9 carbon atoms, being straight or branched, R_2 each is an alkyl having 1 to 4 carbon atoms, being straight or branched, and n is a positive number of more than 1 up to 30 on the average.

3. The process according to claim 1, wherein the polyol component includes 1 to 50 % by weight of the tertiary aminoalcohol having the formula (I).

4. The process according to claim 1, wherein a tertiary aminoalcohol having the following general formula (II):

$$HO-[-R_3-\overset{\displaystyle R_4}{\overset{|}{N}}-]_m-R_4 \qquad (II)$$

in which R_3 each is an alkylene having 2 to 24 carbon atoms, being straight or branched, a cycloalkylene having 3 to 24 carbon atoms, an alicyclic alkylene having 4 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group, an arylene having 6 to 24 carbon atoms, an aralkylene having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being

a positive number, R_4 each is an alkyl having 1 to 24 carbon atoms, being straight or branched, an aryl having 6 to 24 carbon atoms or an aralkyl having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group and m is a positive number of 1 to 50 on the average; is used as a third component in the step of reacting a polyisocyanate component with the polyol component.

5. The process according to claim 4, wherein the amount of the third component having the formula (II) is 30 % and less by weight based on the total amount of the tertiary aminoalcohol having the formula (I) and the tertiary aminoalcohol having the formula (II).

6. The process according to claim 4, wherein R_3 each is an alkylene having 6 to 9 carbon atoms, being straight or branched, R_4 each is an alkyl having 1 to 4 carbon atoms, being straight or branched, and m is a positive number of 1 to 30 on the average.

7. A polyurethane produced by the process of claim 1 or 4.

8. A process for producing a polyurethane foam, comprising the step of reacting a polyisocyanate component with a polyol component coexisting of a foaming agent, the polyol component comprising, as all or part thereof, a tertiary aminoalcohol having the formula (I):

$$\mathrm{HO{-}[{-}R_1{-}\underset{}{\overset{\displaystyle R_2 \atop |}{N}}{-}]_n{-}R_1{-}OH} \qquad (\mathrm{I})$$

in which R_1 each is an alkylene having 2 to 24 carbon atoms, being straight or branched, a cycloalkylene having 3 to 24 carbon atoms, an alicyclic alkylene having 4 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group, an arylene having 6 to 24 carbon atoms, an aralkylene having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being a positive number, R_2 each is an alkyl having 1 to 24 carbon atoms, being straight or branched, an aryl having 6 to 24 carbon atoms or an aralkyl having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group and n is a positive number of more than 1 up to 50 on the average.

9. The process according to claim 8, wherein R_1 each is an alkylene having 6 to 9 carbon atoms, being straight or branched, R_2 each is an alkyl having 1 to 4 carbon atoms, being straight or branched, and n is a positive number of more than 1 up to 30 on the average.

10. The process according to claim 8, wherein the polyol component includes 1 to 50 % by weight of the tertiary aminoalcohol having the formula (I).

11. The process according to claim 8, wherein a tertiary aminoalcohol having the following general formula (II):

$$\mathrm{HO{-}[{-}R_3{-}\overset{\displaystyle R_4 \atop |}{N}{-}]_m{-}R_4} \qquad (\mathrm{II})$$

in which R_3 each is an alkylene having 2 to 24 carbon atoms, being straight or branched, a cycloalkylene having 3 to 24 carbon atoms, an alicyclic alkylene having 4 to 24 carbon atoms and carrying 1 to 6 carbon atoms- in the alkylene group, an arylene having 6 to 24 carbon atoms, an aralkylene having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being a positive number, R_4 each is an alkyl having 1 to 24 carbon atoms, being straight or branched, an aryl having 6 to 24 carbon atoms or an aralkyl having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group and m is a positive number of 1 to 50 on the average;
is used as a third component in the step of reacting a polyisocyanate component with the polyol component.

12. The process according to claim 11, wherein the amount of the third component having the formula (II) is 30 % and less by weight based on the total amount of the tertiary aminoalcohol having the formula (I) and the tertiary ami-

noalcohol having the formula (II).

13. The process according to claim 11, wherein R_3 each is an alkylene having 6 to 9 carbon atoms, being straight or branched, R_4 each is an alkyl having 1 to 4 carbon atoms, being straight or branched, and m is a positive number of 1 to 30 on the average.

14. The process according to claim 8 or 11, wherein a compound selected from the group consisting of aliphatic amines and aromatic amines is used in the step of reacting a polyisocyanate component with the polyol component.

15. The process according to claim 14, wherein the amount of the compound selected from the group consisting of aliphatic amines and aromatic amines is 1 to 30 parts by weight based on 100 parts by weight of the total amount of the polyol component.

16. The process according to claim 8 or 11, wherein one or more compound selected from the group consisting of triethanolamine, tolylenediamine and a diamine compound represents by general formula (III):

$$H_2N\text{-}R_5\text{-}NH_2 \qquad \text{(III)}$$

in which R_5 is an alkylene having 2 to 8 carbon atoms, being straight or branched; is used in the step of reacting a polyisocyanate component with the polyol component.

17. The process according to claim 8 or 11, wherein the foaming agent is selected from the group consisting of H_2O, 1,1-dichloro-2,2,2-trifluoroethane and 2-dichloro-2-trifluoroethane.

18. The process according to claim 8 or 11, wherein the polyurethane foam is a rigid polyurethane foam.

19. The process according to claim 18, wherein the polyol component includes a polyol having the OH value being 1000 and above.

20. The process according to claim 18, wherein the polyol component includes ethyleneglycol and/or glycerol.

21. The process according to claim 18, wherein an average OH value of the polyol component is 300 and above.

22. The process according to claim 8 or 11, wherein the polyurethane foam is a flexible polyurethane foam.

23. The process according to claim 22, wherein an average OH value of the polyol component is 200 and below.

24. The process according to claim 22, wherein the foaming agent is H_2O and the foaming agent is used in amount of 2 to 8 parts by weight based on 100 parts by weight of the total amount of the polyol component.

25. A process for producing a polyurethane foam by spray method, comprising the step of spraying a mixture containing reacting raw materials and a foaming agent and the step of reacting a polyisocyanate component with a polyol component coexisting of a foaming agent, the polyol component comprising, as all or part thereof, a tertiary aminoalcohol having the formula (I):

$$HO\text{-}[\text{-}R_1\text{-}\underset{}{\overset{R_2}{\overset{|}{N}}}\text{-}]_n\text{-}R_1\text{-}OH \qquad \text{(I)}$$

in which R_1 each is an alkylene having 2 to 24 carbon atoms, being straight or branched, a cycloalkylene having 3 to 24 carbon atoms, an alicyclic alkylene having 4 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group, an arylene having 6 to 24 carbon atoms, an aralkylene having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being a positive number, R_2 each is an alkyl having 1 to 24 carbon atoms, being straight or branched, an aryl having 6 to 24 carbon atoms or an aralkyl having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene

group and n is a positive number of more than 1 up to 50 on the average; and H_2O being used as the foaming agent in amount of 2 to 8 parts by weight based on 100 parts by weight of the total amount of the polyol component.

26. The process according to claim 25, wherein R_1 each is an alkylene having 6 to 9 carbon atoms, being straight or branched, R_2 each is an alkyl having 1 to 4 carbon atoms, being straight or branched, and n is a positive number of more than 1 up to 30 on the average.

27. The process according to claim 25, wherein the polyol component includes 1 to 50 % by weight of the tertiary aminoalcohol having the formula (I).

28. The process according to claim 25, wherein a tertiary aminoalcohol having the following general formula (II):

$$HO\text{-}[\text{-}R_3\text{-}\underset{\displaystyle}{\overset{\displaystyle R_4 \atop |}{N}}\text{-}]_m\text{-}R_4 \qquad \text{(II)}$$

in which R_3 each is an alkylene having 2 to 24 carbon atoms, being straight or branched, a cycloalkylene having 3 to 24 carbon atoms, an alicyclic alkylene having 4 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group, an arylene having 6 to 24 carbon atoms, an aralkylene having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group or $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p being zero or a positive number, q being a positive number, R_4 each is an alkyl having 1 to 24 carbon atoms, being straight or branched, an aryl having 6 to 24 carbon atoms or an aralkyl having 7 to 24 carbon atoms and carrying 1 to 6 carbon atoms in the alkylene group and m is a positive number of 1 to 50 on the average; is used as a third component in the step of reacting a polyisocyanate component with the polyol component.

29. The process according to claim 28, wherein the amount of the third component having the formula (II) is 30 % and less by weight based on the total amount of the tertiary aminoalcohol having the formula (I) and the tertiary aminoalcohol having the formula (II).

30. The process according to claim 28, wherein R_3 each is an alkylene having 6 to 9 carbon atoms, being straight or branched, R_4 each is an alkyl having 1 to 4 carbon atoms, being straight or branched, and m is a positive number of 1 to 30 on the average.

Patentansprüche

1. Verfahren zur Erzeugung eines Polyurethans, umfassend den Schritt der Reaktion einer Polyisocyanat-Komponente mit einer Polyol-Komponente, worin die Polyol-Komponente als Gesamtes oder einen Teil davon einen tertiären Aminoalkohol mit der Formel (I) umfaßt:

$$HO\text{-}[\text{-}R_1\text{-}\overset{\displaystyle R_2 \atop |}{N}\text{-}]_n\text{-}R_1\text{-}OH \qquad \text{(I)}$$

worin R_1 jeweils ein Alkylen mit 2 bis 24 Kohlenstoffatomen, geradkettig oder verzweigt, ein Cycloalkylen mit 3 bis 24 Kohlenstoffatomen, ein alicyclisches Alkylen mit 4 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe, ein Arylen mit 6 bis 24 Kohlenstoffatomen, ein Aralkylen mit 7 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe oder $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$ ist, worin p Null oder eine positive Zahl, q eine positive Zahl sind, R_2 jeweils ein Alkyl mit 1 bis 24 Kohlenstoffatomen, geradkettig oder verzweigt, ein Aryl mit 6 bis 24 Kohlenstoffatomen oder ein Aralkyl mit 7 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe ist und n eine positive Zahl von mehr als 1 und bis zu 50 im Durchschnitt ist.

2. Verfahren nach Anspruch 1, worin R_1 jeweils ein Alkylen mit 6 bis 9 Kohlenstoffatomen, geradkettig oder verzweigt, R_2 jeweils ein Alkyl mit 1 bis 4 Kohlenstoffatomen, geradkettig oder verzweigt, und n eine positive Zahl von mehr als 1 und bis zu 30 im Durchschnitt ist.

3. Verfahren nach Anspruch 1, worin die Polyol-Komponente 1 bis 50 Gew.-% des tertiären Aminoalkohols mit der Formel (I) enthält.

4. Verfahren nach Anspruch 1, worin ein tertiärer Aminoalkohol mit der folgenden allgemeinen Formel (II):

$$HO-[-R_3-\underset{}{\overset{R_4}{\overset{|}{N}}}-]_m-R_4 \qquad (II)$$

worin R_3 jeweils ein Alkylen mit 2 bis 24 Kohlenstoffatomen, geradkettig oder verzweigt, ein Cycloalkylen mit 3 bis 24 Kohlenstoffatomen, ein alicyclisches Alkylen mit 4 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe, ein Arylen mit 6 bis 24 Kohlenstoffatomen, ein Aralkylen mit 7 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe oder $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$ ist, worin p Null oder eine positive Zahl, q eine positive Zahl sind, R_4 jeweils ein Alkyl mit 1 bis 24 Kohlenstoffatomen, geradkettig oder verzweigt, ein Aryl mit 6 bis 24 Kohlenstoffatomen oder ein Aralkyl mit 7 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe, und m eine positive Zahl von 1 bis 50 im Durchschnitt ist; als eine dritte Komponente bei der Reaktion einer Polyisocyanat-Komponente mit der Polyol-Komponente verwendet wird.

5. Verfahren nach Anspruch 4, worin die Menge der dritten Komponente mit der Formel (II) 30 Gew.-% und weniger, bezogen auf die Gesamtmenge des tertiären Aminoalkohols mit der Formel (I) und des tertiären Aminoalkohols mit der Formel (II) ist.

6. Verfahren nach Anspruch 4, worin R_3 jeweils ein Alkylen mit 6 bis 9 Kohlenstoffatomen, geradkettig oder verzweigt, R_4 jeweils ein Alkyl mit 1 bis 4 Kohlenstoffatomen, geradkettig oder verzweigt, und n eine positive Zahl von 1 bis 30 im Durchschnitt sind.

7. Polyurethan, hergestellt durch das Verfahren nach Anspruch 1 oder 4.

8. Verfahren zur Erzeugung eines Polyurethanschaumes, umfassend die Reaktion einer Polyisocyanat-Komponente mit einer Polyol-Komponente, die mit einem Schäummittel koexistiert, wobei die Polyol-Komponente als Gesamtes oder einen Teil davon einen tertiären Aminoalkohol mit der Formel (I) enthält:

$$HO-[-R_1-\overset{R_2}{\overset{|}{N}}-]_n-R_1-OH \qquad (I)$$

worin R_1 jeweils ein Alkylen mit 2 bis 24 Kohlenstoffatomen, geradkettig oder verzweigt, ein Cycloalkylen mit 3 bis 24 Kohlenstoffatomen, ein alicyclisches Alkylen mit 4 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe, ein Arylen mit 6 bis 24 Kohlenstoffatomen, ein Aralkylen mit 7 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe oder $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$ ist, worin p Null oder eine positive Zahl, q eine positive Zahl sind, R_2 jeweils ein Alkyl mit 1 bis 24 Kohlenstoffatomen, geradkettig oder verzweigt, ein Aryl mit 6 bis 24 Kohlenstoffatomen oder ein Aralkyl mit 7 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe ist und n eine positive Zahl von mehr als 1 und bis zu 50 im Durchschnitt ist.

9. Verfahren nach Anspruch 8, worin R_1 jeweils ein Alkylen mit 6 bis 9 Kohlenstoffatomen, geradkettig oder verzweigt, R_2 jeweils ein Alkyl mit 1 bis 4 Kohlenstoffatomen, geradkettig oder verzweigt, und n eine positive Zahl von mehr als 1 und bis zu 30 im Durchschnitt sind.

10. Verfahren nach Anspruch 8, worin die Polyol-Komponente 1 bis 50 Gew.-% des tertiären Aminoalkohols mit der Formel (I) enthält.

11. Verfahren nach Anspruch 8, worin einer tertiärer Aminoalkohol mit der folgenden allgemeinen Formel (II):

$$\mathrm{HO{-}[{-}R_3{-}\overset{\displaystyle R_4}{\overset{|}{N}}{-}]_m{-}R_4} \qquad \text{(II)}$$

worin R_3 jeweils ein Alkylen mit 2 bis 24 Kohlenstoffatomen, geradkettig oder verzweigt, ein Cycloalkylen mit 3 bis 24 Kohlenstoffatomen, ein alicyclisches Alkylen mit 4 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe, ein Arylen mit 6 bis 24 Kohlenstoffatomen, ein Aralkylen mit 7 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe oder $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$ ist, worin p Null oder eine positive Zahl, q eine positive Zahl sind, R_4 jeweils ein Alkyl mit 1 bis 24 Kohlenstoffatomen, geradkettig oder verzweigt, ein Aryl mit 6 bis 24 Kohlenstoffatomen oder ein Aralkyl mit 7 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe und m eine positive Zahl von 1 bis 50 Durchschnitt ist; als eine dritte Komponente bei der Reaktion einer Polyisocyanat-Komponente mit der Polyol-Komponente verwendet wird.

12. Verfahren nach Anspruch 11, worin die Menge der dritten Komponente mit der Formel (II) 30 Gew.-% und weniger, bezogen auf die Gesamtmenge des tertiären Aminoalkohols mit der Formel (I) und des tertiären Aminoalkohols mit der Formel (II) ist.

13. Verfahren nach Anspruch 11, worin R_3 jeweils ein Alkylen mit 6 bis 9 Kohlenstoffatomen, geradkettig oder verzweigt, R_4 jeweils ein Alkyl mit 1 bis 4 Kohlenstoffatomen, geradkettig oder verzweigt, und m eine positive Zahl von 1 bis 30 im Durchschnitt sind.

14. Verfahren nach Anspruch 8 oder 11, worin eine Verbindung, ausgewählt aus der Gruppe, bestehend aus aliphatischen Aminen und aromatischen Aminen bei der Reaktion einer Polyisocyanat-Komponente mit der Poyol-Komponente verwendet wird.

15. Verfahren nach Anspruch 14, worin die Menge der Komponente, ausgewählt aus der Gruppe, bestehend aus aliphatischen Aminen und aromatischen Aminen, 1 bis 30 Gew.-Teile ist, bezogen auf 100 Gew.-Teile der Gesamtmenge der Polyol-Komponente.

16. Verfahren nach Anspruch 8 oder 11, worin eine oder mehrere Verbindungen, ausgewählt aus der Gruppe, bestehend aus Triethanolamin, Tolylendiamin und einer Diamin-Verbindung, dargestellt durch die allgemeine Formel (III):

$$H_2N\text{-}R_5\text{-}NH_2 \qquad \text{(III)}$$

worin R_5 ein Alkylen mit 2 bis 8 Kohlenstoffatomen, geradkettig oder verzweigt, ist, bei der Reaktion einer Polyisocyanat-Komponente mit der Polyol-Komponente verwendet wird.

17. Verfahren nach Anspruch 8 oder 11, worin das Schäummittel aus der Gruppe ausgewählt ist, bestehend aus H_2O, 1,1-Dichlor-2,2,2-trifluorethan und 2-Dichlor-2-trifluorethan.

18. Verfahren nach Anspruch 8 oder 11, worin der Polyurethanschaum ein starrer Polyurethanschaum ist.

19. Verfahren nach Anspruch 18, worin die Polyol-Komponente ein Polyol enthält, bei dem der OH-Wert 1000 und mehr ist.

20. Verfahren nach Anspruch 18, worin die Polyol-Komponente Ethylenglykol und/oder Glycerin enthält.

21. Verfahren nach Anspruch 18, worin ein durchschnittlicher OH-Wert der Polyol-Komponente 300 und mehr ist.

22. Verfahren nach Anspruch 8 oder 11, worin der Polyurethanschaum ein flexibler Polyurethanschaum ist.

23. Verfahren nach Anspruch 22, worin ein durchschnittlicher OH-Wert der Polyol-Komponente 200 und weniger ist.

24. Verfahren nach Anspruch 22, worin das Schäummittel H_2O ist und das Schäummittel in einer Menge von 2 bis 8 Gew.-Teilen, bezogen auf 100 Gew.-Teile der Gesamtmenge der Polyol-Komponente, verwendet wird.

25. Verfahren zur Erzeugung eines Polyurethanschaumes durch das Sprühverfahren, umfassend das Sprühen einer Mischung, umfassend reagierende Ausgangsmaterialien und ein Schäummittel, und die Reaktion einer Polyisocyanat-Komponente mit einer Polyol-Komponente, die mit einem Schäummittel koexistiert, wobei die Polyol-Komponente als Gesamtes oder Teil davon einen tertiären Aminoalkohol mit der Formel (I) enthält:

$$\mathrm{HO{-}[{-}R_1{-}\underset{\displaystyle}{\overset{\displaystyle R_2}{\overset{|}{N}}}{-}]_n{-}R_1{-}OH} \qquad \text{(I)}$$

worin R_1 jeweils ein Alkylen mit 2 bis 24 Kohlenstoffatomen, geradkettig oder verzweigt, ein Cycloalkylen mit 3 bis 24 Kohlenstoffatomen, ein alicyclisches Alkylen mit 4 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe, ein Arylen mit 6 bis 24 Kohlenstoffatomen, ein Aralkylen mit 7 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe oder $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$ ist, worin p Null oder eine positive Zahl, q eine positive Zahl sind, R_2 jeweils ein Alkyl mit 1 bis 24 Kohlenstoffatomen, geradkettig oder verzweigt, ein Aryl mit 6 bis 24 Kohlenstoffatomen oder ein Aralkyl mit 7 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe ist und n eine positive Zahl von mehr als 1 und bis zu 50 im Durchschnitt ist; und wobei H_2O als Schäummittel in einer Menge von 2 bis 8 Gew.-Teilen, bezogen auf 100 Gew.-Teile der Gesamtmenge der Polyol-Komponente verwendet wird.

26. Verfahren nach Anspruch 25, worin R_1 jeweils ein Alkylen mit 6 bis 9 Kohlenstoffatomen, geradkettig oder verzweigt, R_2 jeweils ein Alkyl mit 1 bis 4 Kohlenstoffatomen, geradkettig oder verzweigt, und n eine positive Zahl von mehr als 1 und bis zu 30 im Durchschnitt sind.

27. Verfahren nach Anspruch 25, worin die Polyol-Komponente 1 bis 50 Gew.-% des tertiären Aminoalkohols mit der Formel (I) umfaßt.

28. Verfahren nach Anspruch 25, worin ein tertiärer Aminoalkohol mit der folgenden allgemeinen Formel (II):

$$\mathrm{HO{-}[{-}R_3{-}\overset{\displaystyle R_4}{\overset{|}{N}}{-}]_m{-}R_4} \qquad \text{(II)}$$

worin R_3 jeweils ein Alkylen mit 2 bis 24 Kohlenstoffatomen, geradkettig oder verzweigt, ein Cycloalkylen mit 3 bis 24 Kohlenstoffatomen, ein alicyclisches Alkylen mit 4 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe, ein Arylen mit 6 bis 24 Kohlenstoffatomen, ein Aralkylen mit 7 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe oder $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$ ist, worin p Null oder eine positive Zahl, q eine positive Zahl sind, R_4 jeweils ein Alkyl mit 1 bis 24 Kohlenstoffatomen, geradkettig oder verzweigt, ein Aryl mit 6 bis 24 Kohlenstoffatomen oder ein Aralkyl mit 7 bis 24 Kohlenstoffatomen und 1 bis 6 Kohlenstoffatomen in der Alkylen-Gruppe und m eine positive Zahl von 1 bis 50 Durchschnitt ist; als eine dritte Komponente bei der Reaktion einer Polyisocyanat-Komponente mit der Polyol-Komponente verwendet wird.

29. Verfahren nach Anspruch 28, worin die Menge der dritten Komponente mit der Formel (II) 30 Gew.-% und weniger ist, bezogen auf die Gesamtmenge des tertiären Aminoalkohols mit der Formel (I) und des tertiären Aminoalkohols mit der Formel (II).

30. Verfahren nach Anspruch 28, worin R_3 jeweils ein Alkylen mit 6 bis 9 Kohlenstoffatomen, geradkettig oder verzweigt, R_4 jeweils ein Alkyl mit 1 bis 4 Kohlenstoffatomen, geradkettig oder verzweigt, und m eine positive Zahl von 1 bis 30 im Durchschnitt sind.

Revendications

1. Procédé de production d'un polyuréthane comprenant l'étape consistant à faire réagir un composant de polyisocyanate avec un composant de polyol, le composant de polyol comprenant, comme tout ou partie, un tertio-aminoalcool répondant à la formule (I) :

$$HO-[-R_1-\underset{\displaystyle R_2}{\overset{|}{N}}-]_n-R_1-OH \qquad (I)$$

dans laquelle les symboles R_1 représentent chacun un groupe alkylène ayant 2 à 24 atomes de carbone, linéaire ou ramifié, un groupe cycloalkylène ayant 3 à 24 atomes de carbone, un groupe alkylène alicyclique ayant 4 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène, un groupe arylène ayant 6 à 24 atomes de carbone, un groupe aralkylène ayant 7 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène ou un groupe $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p étant égal à zéro ou à un nombre positif, q étant un nombre positif, les symboles R_2 représentent chacun un groupe alkyle ayant 1 à 24 atomes de carbone, linéaire ou ramifié, un groupe aryle ayant 6 à 24 atomes de carbone ou un groupe aralkyle ayant 7 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène, et n est un nombre positif de plus de 1 et pouvant aller jusqu'à 50 en moyenne.

2. Procédé selon la revendication 1, dans lequel les symboles R_1 représentent chacun un groupe alkylène ayant 6 à 9 atomes de carbone, linéaire ou ramifié, les symboles R_2 représentent chacun un groupe alkyle ayant 1 à 4 atomes de carbone, linéaire ou ramifié, et n est un nombre positif de plus de 1 et pouvant aller jusqu'à 30, en moyenne.

3. Procédé selon la revendication 1, dans lequel le composant de polyol comprend de 1 à 50 % en poids du tertio-aminoalcool répondant à la formule (I).

4. Procédé selon la revendication 1, dans lequel on utilise un tertio-aminoalcool répondant à la formule générale (II) suivante :

$$HO-[-R_3-\overset{\displaystyle R_4}{\overset{|}{N}}-]_n-R_4 \qquad (II)$$

dans laquelle les symboles R_3 représentent chacun un groupe alkylène ayant 2 à 24 atomes de carbone, linéaire ou ramifié, un groupe cycloalkylène ayant 3 à 24 atomes de carbone, un groupe alkylène alicyclique ayant 4 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène, un groupe arylène ayant 6 à 24 atomes de carbone, un groupe aralkylène ayant 7 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène ou un groupe $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p étant égal à zéro ou à un nombre positif, q étant un nombre positif, les symboles R_4 représentent chacun un groupe alkyle ayant 1 à 24 atomes de carbone, linéaire ou ramifié, un groupe aryle ayant 6 à 24 atomes de carbone ou un groupe aralkyle ayant 7 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène, et m est un nombre positif de 1 à 50 en moyenne; comme troisième composant dans l'étape consistant à faire réagir un composant de polyisocyanate avec le composant de polyol.

5. Procédé selon la revendication 4, dans lequel la quantité du troisième composant répondant à la formule (II) est de 30 % en poids et moins, exprimée par rapport à la quantité totale du tertio-aminoalcool répondant à la formule (I) et du tertio-aminoalcool répondant à la formule (II).

6. Procédé selon la revendication 4, dans lequel les symboles R_3 représentent chacun un groupe alkylène ayant 6 à 9 atomes de carbone, linéaire ou ramifié, les symboles R_4 représentent chacun un groupe alkyle ayant 1 à 4 atomes de carbone, linéaire ou ramifié, et m est un nombre positif de 1 à 30 en moyenne.

7. Polyuréthane produit par le procédé de la revendication 1 ou 4.

8. Procédé de production d'une mousse de polyuréthane comprenant l'étape consistant à faire réagir un composant de polyisocyanate avec un composant de polyol en présence d'un agent d'expansion, le composant de polyol comprenant, comme tout ou partie, un tertio-aminoalcool répondant à la formule (I) :

$$HO-[-R_1-\underset{\displaystyle R_2}{\overset{|}{N}}-]_n-R_1-OH \qquad (I)$$

dans laquelle les symboles R_1 représentent chacun un groupe alkylène ayant 2 à 24 atomes de carbone, linéaire ou ramifié, un groupe cycloalkylène ayant 3 à 24 atomes de carbone, un groupe alkylène alicyclique ayant 4 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène, un groupe arylène ayant 6 à 24 atomes de carbone, un groupe aralkylène ayant 7 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène ou un groupe $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p étant égal à zéro ou à un nombre positif, q étant un nombre positif, les symboles R_2 représentent chacun un groupe alkyle ayant 1 à 24 atomes de carbone, linéaire ou ramifié, un groupe aryle ayant 6 à 24 atomes de carbone ou un groupe aralkyle ayant 7 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène, et n est un nombre positif de plus de 1 et pouvant aller jusqu'à 50 en moyenne.

9. Procédé selon la revendication 8, dans lequel les symboles R_1 représentent chacun un groupe alkylène ayant 6 à 9 atomes de carbone, linéaire ou ramifié, les symboles R_2 représentent chacun un groupe alkyle ayant 1 à 4 atomes de carbone, linéaire ou ramifié, et n est un nombre positif de plus de 1 et pouvant aller jusqu'à 30, en moyenne.

10. Procédé selon la revendication 8, dans lequel le composant de polyol comprend de 1 à 50 % en poids du tertio-aminoalcool répondant à la formule (I).

11. Procédé selon la revendication 8, dans lequel on utilise un tertio-aminoalcool répondant à la formule générale (II) suivante :

$$HO-[-R_3-\underset{\displaystyle R_4}{\overset{|}{N}}-]_m-R_4 \qquad (II)$$

dans laquelle les symboles R_3 représentent chacun un groupe alkylène ayant 2 à 24 atomes de carbone, linéaire ou ramifié, un groupe cycloalkylène ayant 3 à 24 atomes de carbone, un groupe alkylène alicyclique ayant 4 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène, un groupe arylène ayant 6 à 24 atomes de carbone, un groupe aralkylène ayant 7 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène ou un groupe $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p étant égal à zéro ou à un nombre positif, q étant un nombre positif, les symboles R_4 représentent chacun un groupe alkyle ayant 1 à 24 atomes de carbone, linéaire ou ramifié, un groupe aryle ayant 6 à 24 atomes de carbone ou un groupe aralkyle ayant 7 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène, et m est un nombre positif de 1 à 50 en moyenne, comme troisième composant dans l'étape consistant à faire réagir un composant de polyisocyanate avec le composant de polyol.

12. Procédé selon la revendication 11, dans lequel la quantité du troisième composant répondant à la formule (II) est de 30 % en poids et moins, exprimée par rapport à la quantité totale du tertio-aminoalcool répondant à la formule (I) et du tertio-aminoalcool répondant à la formule (II).

13. Procédé selon la revendication 11, dans lequel les symboles R_3 représentent chacun un groupe alkylène ayant 6 à 9 atomes de carbone, linéaire ou ramifié, les symboles R_4 représentent chacun un groupe alkyle ayant 1 à 4 atomes de carbone, linéaire ou ramifié, et m est un nombre positif de 1 à 30 en moyenne.

14. Procédé selon la revendication 8 ou 11, dans lequel on utilise un composé choisi dans le groupe constitué d'amines aliphatiques et d'amines aromatiques dans l'étape consistant à faire réagir un composant de polyisocyanate avec le composant de polyol.

15. Procédé selon la revendication 14, dans lequel la quantité du composé choisi dans le groupe constitué d'amines aliphatiques et d'amines aromatiques est de 1 à 30 parties en poids, exprimée pour 100 parties en poids de la quantité totale du composant de polyol.

16. Procédé selon la revendication 8 ou 11, dans lequel on utilise un ou plusieurs composés choisis dans le groupe constitué de la triéthanolamine, de la tolylènediamine et d'un composé de type diamine représenté par la formule générale (III) :

$$H_2N\text{-}R_5\text{-}NH_2 \qquad \text{(III)}$$

dans laquelle R_5 représente un groupe alkylène ayant 2 à 8 atomes de carbone, linéaire ou ramifié; dans l'étape consistant à faire réagir un composant de polyisocyanate avec un composant de polyol.

17. Procédé selon la revendication 8 ou 11, dans lequel l'agent d'expansion est choisi dans le groupe constitué de H_2O, le 1,1-dichloro-2,2,2-trifluoroéthane et le 2-dichloro-2-trifluoroéthane.

18. Procédé selon la revendication 8 ou 11, dans lequel la mousse de polyuréthane est une mousse de polyuréthane rigide.

19. Procédé selon la revendication 18, dans lequel le composant de polyol comprend un polyol ayant un indice d'OH égal à 1000 et plus.

20. Procédé selon la revendication 18, dans lequel le composant de polyol comprend l'éthylèneglycol et/ou le glycérol.

21. Procédé selon la revendication 18, dans lequel l'indice d'OH moyen du composant de polyol est de 300 et plus.

22. Procédé selon la revendication 8 ou 11, dans lequel la mousse de polyuréthane est une mousse de polyuréthane souple.

23. Procédé selon la revendication 22, dans lequel l'indice d'OH moyen du composant de polyol est de 200 et moins.

24. Procédé selon la revendication 22, dans lequel l'agent d'expansion est H_2O et on utilise l'agent d'expansion en une quantité de 2 à 8 parties en poids, exprimée pour 100 parties en poids de la quantité totale de composant de polyol.

25. Procédé de production d'une mousse de polyuréthane par un procédé de pulvérisation, comprenant l'étape consistant à pulvériser un mélange contenant des matières premières réagissant et un agent d'expansion et l'étape consistant à faire réagir un composant de polyisocyanate avec un composant de polyol en présence d'un agent d'expansion, le composant de polyol comprenant, comme tout ou partie, un tertio-aminoalcool répondant à la formule (I) :

$$HO\text{-}[\text{-}R_1\text{-}\underset{\substack{|\\R_2}}{N}\text{-}]_n\text{-}R_1\text{-}OH \qquad \text{(I)}$$

dans laquelle les symboles R_1 représentent chacun un groupe alkylène ayant 2 à 24 atomes de carbone, linéaire ou ramifié, un groupe cycloalkylène ayant 3 à 24 atomes de carbone, un groupe alkylène alicyclique ayant 4 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène, un groupe arylène ayant 6 à 24 atomes de carbone, un groupe aralkylène ayant 7 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène ou un groupe $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p étant égal à zéro ou à un nombre positif, q étant un nombre positif, les symboles R_2 représentent chacun un groupe alkyle ayant 1 à 24 atomes de carbone, linéaire ou ramifié, un groupe aryle ayant 6 à 24 atomes de carbone ou un groupe aralkyle ayant 7 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène, et n est un nombre positif de plus de 1 et pouvant aller jusqu'à 50 en moyenne; et de l'H_2O étant utilisée comme agent d'expansion en une quantité de 2 à 8 parties en poids, exprimée pour 100 parties en poids de la quantité totale du composant de polyol.

26. Procédé selon la revendication 25, dans lequel les symboles R_1 représentent chacun un groupe alkylène ayant 6 à 9 atomes de carbone, linéaire ou ramifié, les symboles R_2 représentent chacun un groupe alkyle ayant 1 à 4 atomes de carbone, linéaire ou ramifié, et n est un nombre positif de plus de 1 et pouvant aller jusqu'à 30 en moyenne.

27. Procédé selon la revendication 25, dans lequel le composant de polyol comprend 1 à 50 % en poids du tertio-aminoalcool répondant à la formule (I).

28. Procédé selon la revendication 25, dans lequel on utilise un tertio-aminoalcool répondant à la formule générale suivante (II) :

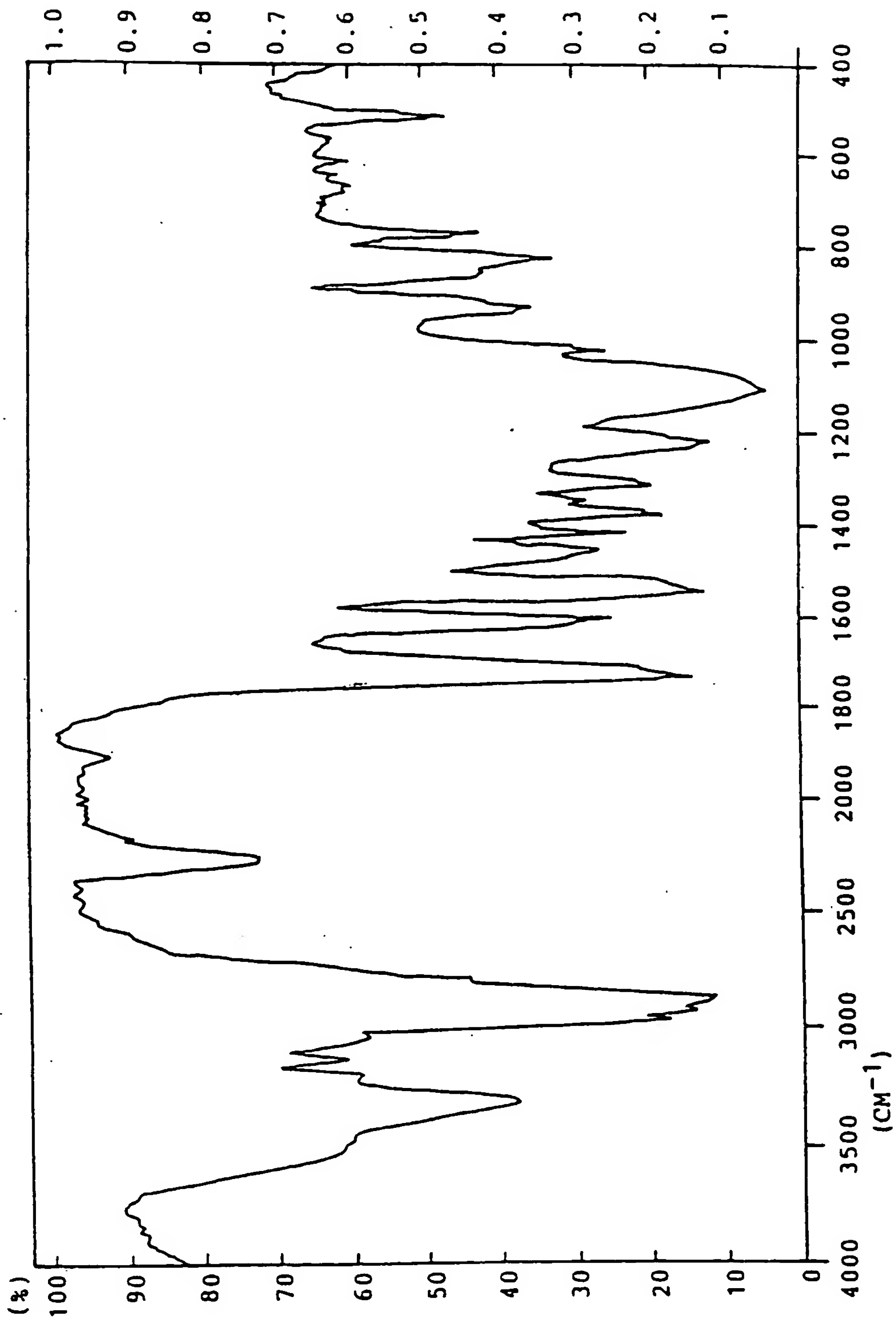
$$HO-[-R_3-\underset{\displaystyle R_4}{\overset{}{N}}-]_m-R_4 \quad (II)$$

dans laquelle les symboles R_3 représentent chacun un groupe alkylène ayant 2 à 24 atomes de carbone, linéaire ou ramifié, un groupe cycloalkylène ayant 3 à 24 atomes de carbone, un groupe alkylène alicyclique ayant 4 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène, un groupe arylène ayant 6 à 24 atomes de carbone, un groupe aralkylène ayant 7 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène ou un groupe $-(CH_2CH_2O)_p-(CH_2CH_2)_q-$, p étant égal à zéro ou à un nombre positif, q étant un nombre positif, les symboles R_4 représentent chacun un groupe alkyle ayant 1 à 24 atomes de carbone, linéaire ou ramifié, un groupe aryle ayant 6 à 24 atomes de carbone ou un groupe aralkyle ayant 7 à 24 atomes de carbone et comportant 1 à 6 atomes de carbone dans le groupe alkylène, et m est un nombre positif de 1 à 50 en moyenne, comme troisième composant dans l'étape consistant à faire réagir le composant de poly-isocyanate avec un composant de polyol.

29. Procédé selon la revendication 28, dans lequel la quantité du troisième composant répondant à la formule (II) est de 30 % en poids et moins, exprimée par rapport à la quantité totale du tertio-aminoalcool répondant à la formule (I) et du tertio-aminoalcool répondant à la formule (II).

30. Procédé selon la revendication 28, dans lequel les symboles R_3 représentent chacun un groupe alkylène ayant 6 à 9 atomes de carbone, linéaire ou ramifié, les symboles R_4 représentent chacun un groupe alkyle ayant 1 à 4 atomes de carbone, linéaire ou ramifié, et m est un nombre positif de 1 à 30 en moyenne.

FIG. 1


(%)
100
90
80
70
60
50
40
30
20
10
0
4000
3500
3000
2500
2000
1800
1600
1400
1200
1000
800
600
400
(CM^{-1})
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1